SEPTEMBER, 1960
No. 248

ASTM Bulletin

American Society for Testing Materials

RESEARCH AND STANDARDS FOR MATERIALS

ASTM BULLETIN

September 1960 **Number 248**

Telephone: LOcust 3-5315 **Cable Address: Testing, Philadelphia**

TECHNICAL PAPERS

ARTICLES

DEPARTMENTS

16,750 copies of this issue printed.

ASTM Bulletin is indexed regularly by Engineering Index Inc.
ASTM Bulletin is available on microfilm from University Microfilms, Ann Arbor, Mich.

The Society is not responsible, as a body, for the statements and opinions advanced in this publication.

ASTM Bulletin, published eight times a year, January, February, April, May, July, September, October, and December, by the American Society for Testing Materials. Publication Office—20th and Northampton Sts., Easton, Pa. Editorial and advertising offices at the Headquarters of the Society, 1916 Race St., Philadelphia 3, Pa. Subscriptions, United States and possessions, one year, $3.50, two years, $6.00, three years, $8.50; Canada, one year, $4.00, two years, $7.00, three years, $10.00. Other countries, one year, $4.50, two years, $8.00, three years $11.50. Single Copies—75 cents. Second-class mail privileges authorized at Easton, Pa.

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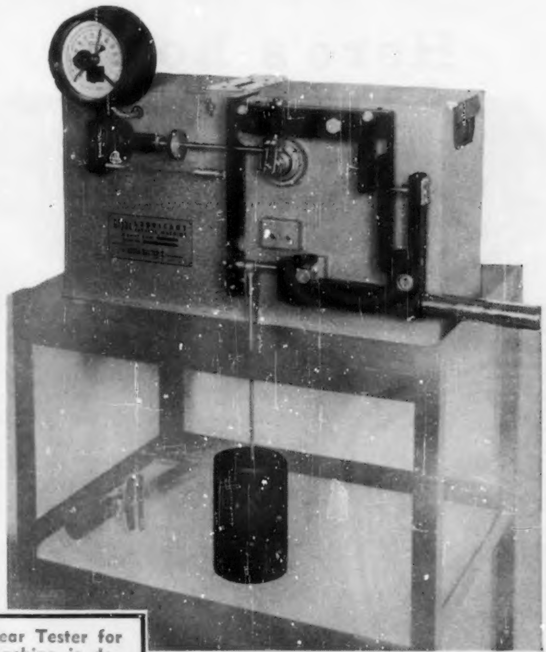

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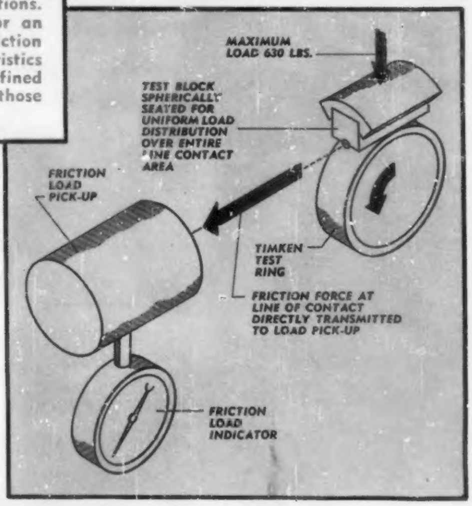

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ASTM BULLETIN

Research and Standards for Materials

Number 248 September 1960

Sound Standards Stimulate Manufacturing*

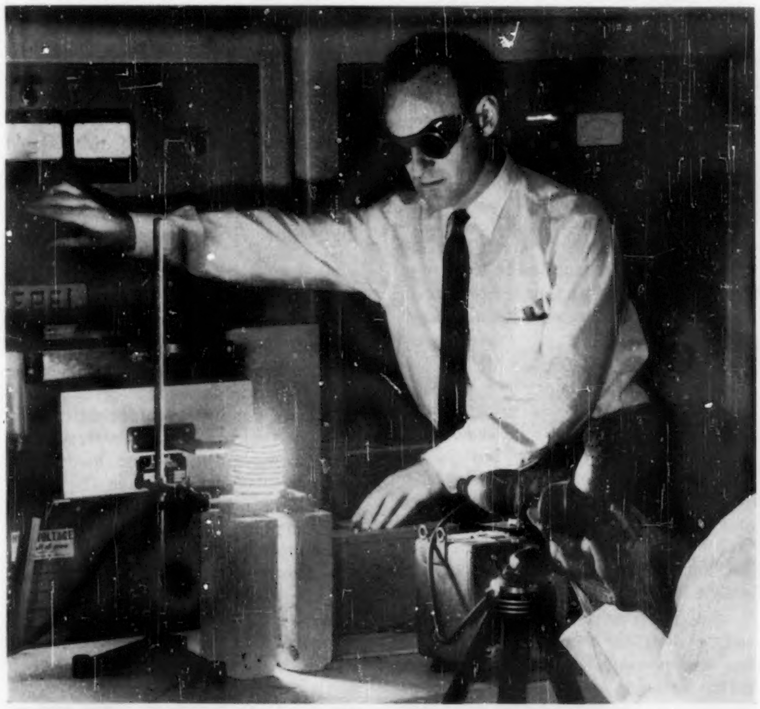
By PAUL McCOY

This article defines standards and traces their development from pristine mankind to the present. It differentiates industrial standards from the absolute standards of science. It pictures their dynamic aspects—their relation to industrial progress and the future. It tells how companies acquire standards and what principles guide national standardizing bodies such as ASTM and the American Standard Assn. It dissects a manufacturing business to show how it depends on standards when it equips and lays out its plant, chooses raw materials, and sets up quality controls on processing and marketing. It shows by an example how progress is tied to standards and why they must be kept dynamic to safeguard our economy, our future, and the future of the work.

SOUND STANDARDS should be dynamic! Are they? Before entering this "sanctuary" of standards we should prepare ourselves. To do this let's adopt the simple concept of standards as rungs in a ladder which have given man a means of rising above his environment. These rungs are established working records of the best knowledge available to date. As such they represent the best available material, process, method, or product for a particular purpose.

Early man developed standards or practices through observation and necessity. He observed the rhythm of natural processes—the needs for food, protective clothing, and shelter were man's early incentives. Measurement was among his first intellectual achievements. He learned how to measure before he could write; it was through measuring that he learned to count. Quoting Lord Kelvin, "When you can measure what you are speaking about and express it in numbers, you know something about it."

Because he could measure, man could become a carpenter, a worker in clay and metals, an astronomer, a navigator, and a merchant. Measurement has been indispensable to man's inquiries into the properties of nature. Early measurements were based on parts of the body. The breadth of a thumb was roughly an inch; the palm 4 in.; the span of the hand 9 in.; the foot 12 in.; the cubit, measured from the elbow to the tip of the middle finger, 18 in.; the yard, from the center of the body to the fingertips with arm outstretched, was 36 in. The fathom was the distance spanned by extended



OBSERVING THE MELTING BEHAVIOR OF A CERAMIC MATERIAL

A crucible holds a ceramic specimen inside a glowing graphite susceptor which is surrounded by an induction heating coil. The melting behavior of the specimen, visible through a small hole in the crucible, is observed with an optical pyrometer. Twelfth ASTM Photographic Exhibit. W. R. Smallwood, National Bureau of Standards, Washington, D. C.

* Presented at the Third Pacific Area National Meeting of ASTM, San Francisco, Calif., Oct. 11-16, 1959.

arms, or 72 in. Consequently a yard was 3 ft, 2 cubits, or 4 spans.

These natural units were acceptable only so long as man worked alone. When men began working together, bodily differences caused difficulties. Two carpenters measuring beams by their feet or arms would produce beams of unequal length. The measurement standards for a working group were therefore usually established by the leader. He used the dimensions of his body as units. It was, however, inconvenient for him to make every measurement personally. Accordingly, he measured the first beam and let others match its length with subsequent beams. Out of this evolved the measuring stick inscribed with units set by the leader.

The day-to-day standards of groups became the accepted standards of tribes or communities. These, however, did not always agree. The "foot" in one community might differ by 1 or 2 in. from that used in the next. (Even in our present 20th century in Brooklyn, N. Y., there was a time when the city surveyors recognized as legal four different "feet"—the U. S. foot, the Bushwick foot, the Williamsburg foot, and the foot of the 26th Ward. All legal but all different! Some strips of Brooklyn real estate were untaxable because after two surveys made with different units, these strips didn't legally exist.)

A conqueror would enforce the units of his community upon the vanquished group. In this way standards of strong tribes and nations spread. Trades and crafts resisted these changes. The Egyptians, Greeks, and Romans established standards that were respected throughout most of the civilized world. In the Dark Ages, however, all systems disintegrated. When William the Conqueror took over the throne of England in 1066, men had reverted to the use of crude primitive standards—nowhere in the world was there a national system of good repute.

Henry VII, in 1490, adopted an octagonal yard bar, roughly made and crudely subdivided, as a standard. One hundred years later, Elizabeth replaced this with a brass bar ½ in. square. Copies of the Elizabethean yard bar were made and sent to Europe and North America. One copy finally found its way into the vault of the U. S. Treasury and was accepted as our early national standard of length.

The English Parliamentary Committee of 1758 established a reliable Imperial system of weights and measures. Using the best available instruments and methods, a new yard bar and a new Troy pound were made. Seventy years later these were accepted by Parliament and proclaimed the only "original and genuine" standards.

Meanwhile, the French Revolution of the 1790's brought forth the metric system. Fire which destroyed the House of Parliament in 1834 ruined existing British standards. This necessitated the construction of new British standards for length based on careful micrometer measurements of 40 new yard bars. These are the prevailing ultimate standards in the United Kingdom. The standard yard bars were distributed to various countries including the United States along with a new pound. The latter, made of platinum, was based on the 16-oz avoirdupois system. These two units are the foundation of the British Imperial System of Weights and Measures.

Since the time of Washington, Congress has had the sole authority for fixing weights and measures for the United States. In 1836 Congress passed a resolution directing the Secretary of the Treasury to supply states with sets of standards. Two sets of standards based on Bronze No. 11, the new Imperial yard, were supplied the states for use as legal standards within their borders. This action was the beginning of our National Standards. In 1866 the metric system became the only legally recognized system in the United States. This resulted from Congressional action which did two things: first, it said that metric units could be used legally in any business transaction: second, it adopted and published a table showing official conversions of the U. S. units to metric units and *vice versa*. Our own units never received similar Congressional recognition but rest on acceptance by state laws. Since 1893 the United States has had no official yard bar or pound weight. Our fundamental national standards are the meter and the kilogram.

Rise of Manufacturing Standards

Measurement, once an art, became a science when standards passed from the hands of rulers into those of scientists. Standards and science are inseparable. It has been through measurement that most of the laws, axioms, and principles of science have been formulated.

In primitive industries it was possible to judge the suitability of products simply by inspecting them. Nowadays companies have to purchase and market thousands of products whose characteristics can be determined only by elaborate engineering and scientific tests. All buying and selling in which goods do not come under the buyer's eye must be based on some sort of acceptance standards.

Industrial standards are essentially different from the so-called "absolute" standards of science such as, for example, the unit of time. These "absolute" standards, if accurately determined and readily reproducible, are absolute in a very real sense—they are ordinarily not subject to change with advancing knowledge. Industrial standards define our present state of knowledge. They live only so long as they continue to define adequately. This difference is not well understood, and from this misunderstanding arises much difficulty. A standard, in many people's minds, has come to denote something fixed, final, and generally desirable. Dynamic standards create changing industrial standards. They are the sign of industrial progress.

In general, industrial standards define the product and its components in terms of size, shape, color, composition, quality, and performance characteristics. They also apply to manufacturing processes, materials, supplies specifications, test methods, and nomenclature.

Early manufacturing standards were usually based upon the independent judgment of engineers and foremen employed in various plants. These standards were subject to being altered or even discarded with each change in plant administration. Progress was materially impeded by the whole instability of this situation. The growing need for uniformity led to the development and recognition of the value of suitable standards for properly defining the product.

Standards in effect in a company may be an amalgam of those (1) originated within a company or adapted from those of other forms, (2) developed by trade associations, (3) prepared under the auspices of technical societies, (4) formulated and disseminated by national and international standardizing bodies, or (5) originated by state and Federal Government agencies. All reputable companies attempt to keep abreast of developments in standards and to make use of them.

The general principles underlying national standardizing bodies such as the ASTM are to strive for (1) as broad a representation as possible, (2) complete investigation, and (3) discussion of proposals for standards. The consensus of producers, consumers, and general-interest groups are used in the formulation of their standards. Most organizations rely on the committee process to bring proposals for the preparation of standards before their members and to conduct necessary research.

Some bodies, such as the ASTM, maintain standing committees charged with the responsibility for the development and continuing review of standards in particular fields. Others constitute committees on research or appoint in-

vestigating groups as required. Some support technical as well as administrative staffs and others function with skeleton administrative organizations, depending upon sponsoring organizations or members to assume such technical duties as are necessary from time to time.

Decision concerning the make-up of standards is sometimes reached by the responsible committees and sometimes through a poll of the membership. Whatever these arrangements, the guiding rules are to consider conflicting points of view and to promulgate standards that offer the greatest promise of usefulness for the greatest number.

No company can rely solely on its own resources to develop its technology. Its chances of keeping abreast of competition are determined in large part by the ability of its personnel to tap the common fund of knowledge that is potentially available to all. This ability is strongly influenced by the efficiency of communication, which in turn depends on the existence of national and international standards, terms, symbols, weights and measures, methods of test, methods of presenting data, and the like.

On occasion, profits themselves are seriously threatened by the rise of an external standard. The company becomes sharply aware of the need to participate in the decision. For example, assume that the growers of sugar cane propose that the word "sugar" be defined to include only sugar made from cane. The alarmed sugar-beet growers will want a voice in the decision-making process.

Liaison with other companies is therefore an important part of many company programs. This liaison is usually maintained through such channels as trade associations. Company relationships dictate the exchange of standards information. Even in companies having policies restricting the distribution of their standards, exceptions are made to allow standards to be furnished suppliers and technical subcommittees. Some companies hesitate to divulge the technical information and trade practices contained in their standards. For every company that closely guards its standards there is another that freely disseminates all its standards.

Manufacturing is dependent upon profits for its being and continued existence. Do standards relate to profits? Let's dissect the organs of business, analyze the facts, and find the answer to this question.

How does manufacturing get its start? Initially a need must either exist or be created for the commodity. Then one or more interested individuals invest capital in the venture. Building material, tools, machinery, all the necessary equipment for processing must be obtained and set up. Decisions must be made on their selection. How does one decide these things? How can one decide them without reference to standards—standard building codes, manufacturer's equipment standards, various national standards such as ASTM standards, NEMA standards, etc.?

PAUL McCOY entered the employ of American Bitumuls Co., in 1932 upon graduation from Johns Hopkins University with a B.S. degree in Chemical Engineering. After working in manufacturing quality control and development, he progressed to the position of chief chemist, and in 1958 to his present position of assistant to vice president—technical.

Although primarily interested in asphalt products and their application, Mr. McCoy's experience extends to the field of soaps and detergents, soils engineering, pavement design, surfactants, synthetic resins, hydraulic cements, and coal tars. He holds numerous patents in these fields and is author of numerous company test manuals, specifications, and test methods.

The plant is built, fully equipped, and staffed with employees. It is ready to convert raw materials into finished goods. What quality standards should these raw materials meet? Here is a major decision, with direct bearing on present and future profits! In establishing or selecting standards for raw materials, it is important to avoid the extremes of (1) specifying a product of too high a grade because of a feeling of "wanting the best" or of (2) specifying so low a quality that it will give unsatisfactory service or involve the use of uneconomic quantities. The golden mean is to establish raw material standards that will ensure the least expensive product that will do the job satisfactorily.

In actuality standards are tools. Just as we can have up-to-date or outmoded tools so can we have up-to-date or outmoded standards. As a working tool a standard must at all times have a good "cutting edge." Whenever additional information, new developments, or changing conditions in an industry make it desirable, a revision in standards should be promptly carried through. From the point of view of utility (which is the only reason for setting up a standard), it is immaterial whether a standard be revised in one year or in ten years. Revisions should be made when, and only when, conditions make it desirable to "resharpen the tool."

Raw materials have been converted to finished goods. All during the process the use of standards is dictated. Acceptance tests on raw materials, in-process tests to keep the product under control, and standard manufacturing procedures—all these are needed to ensure product conformance with manufacturing standards.

Need for Marketing Standards

Reputable marketing is built on quality of the merchandise. This calls for the establishment of product standards or specifications. The belief is widely held that product performance standards should be used whenever possible in place of standards that rigidly specify certain features of composition, construction, dimension, etc. Given a performance standard to meet or excel, many manufacturers feel that they should be left free to meet requirements in the best way that they can devise

Antiquated building codes provide examples of how standards that are excessively rigid can hinder progress. In many areas, newer materials are prohibited because codes specify materials of a certain type rather than standard performance tests such as resistance to fire, etc.

Performance tests are complicated by the diversity of conditions a finished product encounters. A cement suitable for adhering asphalt tile is marketed. This cement when performance tested at 55 to 105 F shows satisfactory tack and bond properties yet fails when used at a floor temperature of 45 F. The same cement might do an outstanding job over on-grade or above-grade concrete slabs yet fail to perform on a below-grade concrete slab. How can one performance test encompass all conceivable job conditions? We see that there are two obvious shortcomings with performance tests: (1) difficulty in specifying meaningful reproducible test conditions that permit the reliable prediction of product performance in the field, and (2) inability to predict accurately product performance where field conditions materially depart from those used in (1).

How, for example, does one measure the wearing qualities of a pair of nylons or a pair of shoes? How does one determine the durability and performance of asphalt? Tests can readily be conceived. Shoe soles might be tested by abrading, flexing, and twisting. Sim-

ilar tests might be made after the shoes are wetted. Thin layers of asphalt may be rapidly hardened by exposure to high temperatures in an oven. These tests are not necessarily significant. Their findings do not necessarily permit reliable prediction of product performance in actual use. Validating a test of this type can be extremely difficult. Yet frequent examples are evident in which performance tests of this type appear in standards. There are many tests that, although they measure one property of the material, tell nothing relevant to the product's performance.

Proof of successful job performance is undoubtedly the best measuring standard for a product. Once a product has established itself in this manner the key properties of the material may be used to define a quality product standard. Authenticated secondary product standards obtained in this way are of value in marketing commodities.

What has our dissection shown us relative to the dependence of manufacturing on standards?

1. Standards are relied upon in plant selection, construction, and equipment.
2. Standards are used in the selection of suitable raw materials.
3. Control standards are used in processing.
4. Product standards have a necessary place in marketing.

Progress With Standards

Standards have frequently been the target for criticism. Criticisms against standards have been based on a misconception of the standardizing process. This misconception is based on the idea that standardization means to stand still. To a manufacturer a sound standard represents the best way of doing a thing at the moment. If tomorrow he finds a better way he will codify it in a new standard.

"Were it not for standards," says Albert W. Whitney[1], "there would be nothing to stand on to make a fresh advance. All one's energies would be used up in meeting the idiosyncrasies of the immediate moment.

"Standardization is the liberator that relegates the problems that have already been solved to their proper place; namely, to the field of routine, leaving the creative faculties free for the problems that are still unsolved."

To progress is to change—to depart from an old standard to accept a new and better one. This invites conflict between innovation and standardization. The conservative wants to cling to an established standard that has stood the test of time. The innovator is thought of as a radical—an enemy of standardization. An innovation is successful only when it is accepted and becomes a new standard.

By example, let's examine the relationship between standards and progress. Let's assume the need is indicated for a better wrist watch:

The present-day wrist watch is a highly perfected marvel of mechanical skill. Offhand, it would seem to meet all present-day standards for appearance, size, mechanical accuracy, etc. Why do anything about something that is already so well-nigh perfect? Only those highly skilled in the science of watch making realize the shortcomings of the present products. But how can these be commonly recognized—how can the public be made aware of these limitations?

These shortcomings or limitations are only measurable by the existing standards in the industry such as the tolerance on time variation, lack of ruggedness, the necessity for frequent cleaning, etc. Discontent with these standards and the desire for greater perfection led to the development of a new electric wrist watch. This established new standards for accuracy, ruggedness, and over-all performance in a timepiece.

By making the public conscious of these new standards, a desire is created for better merchandise. This is the way progress is made through standards. Man is always reaching for a higher rung on the standards ladder. At the same time the present rung serves as a firm support for his efforts.

We say that, "Sound standards should be dynamic!"

What does this mean—how can something that is standard be dynamic? The word "dynamic" pertains to change or movement. To understand this statement we must recognize the difference between technical standards and the "absolute" standards of science, such as those for time.

Technical or industrial standards define our present state of knowledge. They live only so long as they continue to define adequately. The real danger of stagnation lies not in the use of standards but in adopting a fixed mental attitude that closes the mind to new ideas. Failure to understand the need for preserving an open mind could easily lead to a serious decline in our economy. Only by the continual striving upward can we ensure the future for ourselves—recognizing the present shortcomings in our standards and ever trying pregnant ideas for correction.

Standards of the Future

Five or ten years ago space travel, satellites, and projected trips to the moon were favorite subjects for comic books. "Sensible" people, those with down-to-earth ideas, had little use for such childish stuff. Only uninhibited visionaries felt free to discuss subjects of this nature.

The ASTM Northern California District, jointly with the American Rocket Society, were privileged in the fall of 1954 to hear the late Hans R. Friedrich speak on the subject of "Rocketry—Past, Present, and Future." Just three years later, October 4, 1957, Sputnik I soared into orbit shortly to be followed by the larger Sputnik II. Overnight, public interest and thinking changed. Concern was openly expressed as to the implications of this startling news. People who formerly scoffed at space travel and moon expeditions wanted to know why we hadn't done something.

All of us are aware of the catalytic effect this news has had on speeding up our rocket testing program and our explorations into outer space. Only those of us who work in the field of materials realize the need for more reliable components to cope with the problems of the new age which is upon us. This calls for (1) the development of new, revolutionary types of material with unheard of properties, and (2) the creation and establishment of new and more exacting processes. Out of these, new standards will arise; these, the standards of the future, will in time become the accepted standards of the present.

Lt. General C. S. Irvine said in a recent article:[2] "My purpose has been to remind you of the challenges that lie before us and to solicit your vigorous participation in meeting them. You material folks must get ahead and stay ahead of our hardware designers. You must develop better manufacturing methods and procedures, more precise manufacturing and production standards.

"You can deliver the goods provided you reject the course of complacency, accept the responsibility, and exert your fullest capacities toward solutions to the problems just outlined."

Achieving New Standards

The increasingly rapid development of the newer materials and equipment with new and difficult demands on materials emphasizes the need for adequate test methods and specifications. Without minimizing the great importance of research and development on materials, processes, and equipment, it is equally important to have tests and specifications for control and evaluation of the materials. These are all necessary standards for future technological progress.

The development of newer standards

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[1] Encyclopedia Britannica, Vol. 21, p. 308 (1951).

[2] Lt. General C. S. Irvine, "Super Materials for Super Performance," ASTM Bulletin, No. 218, Dec., 1956, p. 11.

is a complex problem. The satisfactory performance of a product is many times dependent upon construction, service conditions, and the materials with which it is used. These are frequently beyond the control of the manufacturer.

The asphalt industry, with which I am most familiar, is typical of a business where the product performance in a pavement depends largely upon other materials, service conditions, and construction practices. The average pavement contains 16 times as much aggregate as asphalt. The heterogenous, polymorphic character of the stone component makes for an infinite variety of arrangements. Still, with adequate compaction, it is possible to obtain a stone particle arrangement of suitable density and stability. End results as reflected in long-time pavement performance are therefore largely dependent upon (1) the care in selecting the aggregate, and (2) the use of good construction practices.

More and more it is recognized that present material tests on the asphalt have little relation to job performance. Only through simulated job performance types of tests correlated to field performance will we be able to arrive at standards of the future for asphalt and allied engineering materials.

"The beaten path is the Standardized path, beaten smooth by footsteps that stabilize their own standards as the river cuts the channel that guides its flow."[3]

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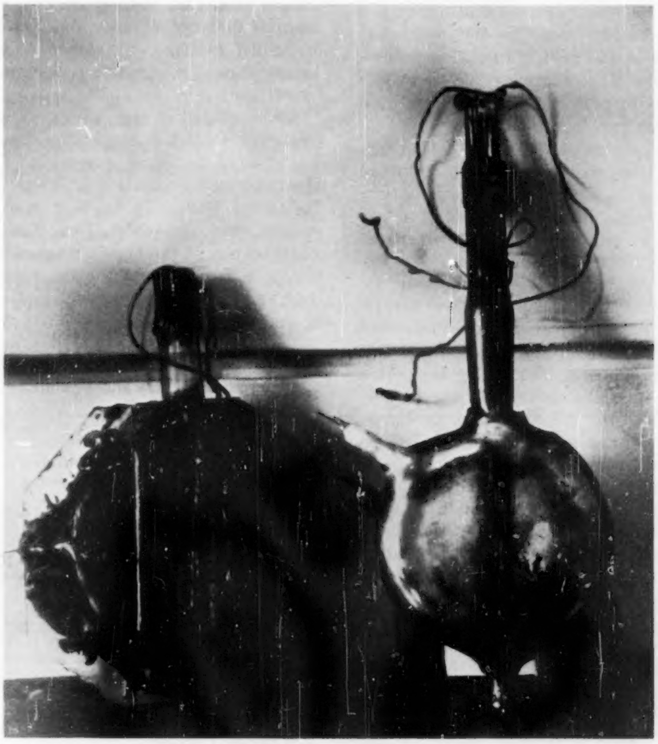
[3] "Standards Year Book," U. S. Department of Commerce, 1928.

The Embryo of the Big Machine

THROUGHOUT the first three decades of the twentieth century, physical apparatus was steadily becoming more complicated and larger. Not until 1929, however, did there truly begin the process that has brought us to the age of the big machine, an apparatus that might be an institute in its own right. The small beginnings of the first of these giants are shown here, pilot models for the cyclotron. These two chambers, the first constructed, were built and tested by E. O. Lawrence at the University of California, just after the Christmas vacation of 1929. They were both made to be used with a magnet having a 4-in. pole piece. The first model (left) was a sealing-wax and string job made of window-glass plates. The second (right) was an improved design using an ordinary laboratory flask which had been collapsed and silvered on the inside. Within a few decades, subsequent models had become kilobuck and eventually megabuck operations.



University of California, Lawrence Radiation Laboratory

Text by Professor Derek J. de Solla Price, Yale University. Copyright; text and photographs reproduced by permission of Professor Price and Arthur D. Little, Inc.

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(10) W. J. Smith, "A Threat to Research," ASTM BULLETIN, No. 218, Dec., 1956, p. 10.

NEW ASTM PUBLICATIONS

Materials in Nuclear Applications

THIS IS THE most extensive volume ever published by ASTM in the nuclear energy field. Included in this one volume are the papers presented at three symposia during the ASTM Third Pacific Area National Meeting: "Radiation Effects and Dosimetry," "Postirradiation Effects in Polymers," and "Ceramics in Nuclear Energy."

The Symposium on Radiation Effects and Dosimetry has a twofold objective: (1) to clarify some of the confusion existing in the field of radiation dosimetry, and (2) to summarize some of the latest data pertaining to the effects of radiation on various materials. A series of seven papers on radiation dosimetry covers the field in a broad manner: radiochemical determination of uranium burnup, recent developments in gamma dosimetry, neutron spectra from activation data, reactor flux by calorimetry, removal dose as an environmental measurement of x-rays and gamma rays, dosimetry nomenclature in the United States, and dosimetry in Europe and the U.S.S.R. The papers on radiation effects cover such topics as: the effects of gamma radiation on electrical properties of Teflon, standardization of terminology for gamma and electron-beam radiation sources, atomistic interpretation of radiation effects in metals, effects of radiation on pressure-vessel steels, dynamic radiation effects testing methods, and a comprehensive survey of published information on the effect of neutron radiation on the mechanical properties of steel.

The Symposium on Postirradiation Effects in Polymers contains four papers describing the existence of long-lived, chemically active, free radicals in irradiated polymers. One paper describes some of the recent techniques for studying the identity, concentration, and lifetime of these species. The other three deal with actual postirradiation changes in physical and chemical properties of a few selected polymer systems.

The Symposium on Ceramics in Nuclear Energy has three general objectives: (1) to promote a better understanding of the wide area in which ceramic materials are used in nuclear reactors, (2) to provide leadership for a discussion forum so that theoretical premises as well as experimental data could be reviewed, and perhaps promote a better understanding of individual problems, and (3) through discussion, to formulate areas of agreement and disagreement, and thus to find common ground for the development of standards, and highlight areas requiring additional study. Subjects covered include the preparation and properties of some refractory uranium compounds; dry-pressing ceramic fuel elements to close tolerances, fabrication and evaluation of urania-alumina fuel elements and boron carbide burnable poison elements; silicon carbide clad graphite matrix fuel elements; graphite as a fuel matrix; and fabrication of U_3O_8-aluminum dispersion fuel elements by extrusion.

Also included in the volume are two papers presented at the Symposium on Technical Developments in the Handling and Utilization of Water and Industrial Water. One describes the system for disposal of radioactive waste waters at the Hanford Operation, the other outlines methods for the determination of radioactive materials in water.

The contents are:

Radiation Effects and Dosimetry

Introduction—V. P. Calkins
The Radiochemical Determination of Uranium Burnup—D. N. Sunderman
Recent Developments in Gamma Ray Dosimetry—S. I. Taimuty
Techniques for Measuring Reactor Neutron Spectra—J. B. Trice
Reactor Monitoring by Calorimetry—K. L. Hall, R. F. Klaver, J. G. Carroll, and R. O. Bolt
Removal Dose for Monitoring Effects of X-rays and Gamma Rays—R. L. Hickmott
Dosimetry Nomenclature in the United States—A. N. Tschaeche
Dosimetry in Europe and the USSR—J. H. Guill and J. Moteff
Effects of Gamma Radiation on Some Electrical Properties of TFE-Fluorocarbon Plastics—W. E. Loy, Jr.
Standardization of Terminology for Gamma and Electro-Beam Radiation Sources—G. E. Danald
Atomistic Interpretation of Radiation Effects in Metals—A. Sosin
Irradiation of Some Pressure-Vessel Steels—L. P. Trudeau
Neutron Radiation Embrittlement at 500 and 650 F of Reactor Pressure-Vessel Steels—J. V. Alger and L. M. Skupien
Dynamic Radiation Effects Testing Methods—D. M. Newell, E. E. Kerlin, R. R. Bauerlein, and R. F. Barrows
Radiation Effects in Steel—L. F. Porter

Postirradiation Effects in Polymers

Introduction—D. J. Metz
The Significance to ASTM of Postirradiation Effects in Irradiated Materials—D. S. Ballantine
Electron Spin Resonance Studies of Free Radicals in Irradiated Materials—L. A. Wall
Postirradiation Oxidation and Molecular Weight Changes in Polystyrene and Poly(Methyl Methacrylate)—W. W. Parkinson and D. Binder
Postirradiation Dielectric Properties of Silicones—C. G. Currin
Postirradiation Effects: Monomers and Polymers—E. F. Degering, G. J. Caldarella, and M. Mancini

Industrial Water for Reactor Use

Disposal of Industrial Radioactive Waste Waters at Hanford—L. C. Schwendiman, R. E. Brown, J. F. Honstead, C. E. Linderoth, and D. W. Pearce
Determination of Radioactive Materials in Water—F. B. Barker

Ceramics in Nuclear Energy

Introduction—J. H. Handwerk
Some Refractory Uranium Compounds—Preparation and Properties—M. J. Snyder and A. B. Tripler, Jr.
Dry Pressing Ceramic Fuel Elements to Close Tolerances—F. J. Hartwig
Fabrication and Evaluation of Urania-Alumina Fuel Elements and Boron Carbide Burnable Poison Elements—L. G. Wisnyi and K. M. Taylor
Silicon Carbide Clad Graphite Matrix Fuel Elements—K. N. Taylor and C. H. McMurty
Graphite as a Fuel Matrix—W. C. Riley
Fabrication of U_3O_8-Aluminum Dispersion Fuel Elements by Extrusion—R. A. Noland, D. E. Walker, and L. C. Hymes

STP 276, 360 pages, hard cover, price $8.25, to members $6.60.

Nondestructive Testing in the Missile Industry

A DESCRIPTION OF the radiography of large solid-propellant rocket motors by the Naval Ordnance Laboratory and a classical treatise of high-energy radiography in the 6- to 30-Mev range by High Voltage Engineering Corp.—these are but two of the interesting subjects discussed in the Symposium on Nondestructive Testing in the Missile Industry. Other papers describe mobile field testing of missiles and aircraft; radiography of weldments in motion; ultrasonic inspection of adhesive-bonded aluminum sandwich structures; an ultrasonic method to detect, count, and measure fluid-contaminating particles; and ultrasonic standards for the evaluation of missile materials and components.

The missile industry, relatively new but highly dynamic, is beset with a multitude of problems involving the measurement of properties and evalua-

tion of materials for extremely severe environmental conditions. Missile materials must withstand severe temperature, pressure, radiation, corrosion, and stress levels to meet design performance. Consequently, nondestructive test methods must be able to furnish quantitative information to ensure that the proper quality levels have been met.

It is obvious that existing nondestructive test methods must be modified in order to meet this need. Also, there remains a vast range of problems relating to performance prediction for which no existing method is adequate. These problems open a new area for the nondestructive testing profession.

This symposium was organized with a twofold purpose: (1) to establish a background of unclassified literature on a limited number of specific applications of nondestructive testing; and (2) to stimulate thinking by outlining many of the present nondestructive testing problems in the missile industry.

The contents are:

Introduction—S. Wenk
Radiography of Large Solid-Propellant Rocket Motors—E. L. Criscuolo, J. A. Holloway, D. Polansky, and C. H. Dyer
Mobile Field Testing of Missiles and Aircraft—A. Barath and D. J. Hagemaier
High-Energy Radiography in the 6- to 30-Mev Range—J. H. Bly and E. A. Burrill
Radiography of Weldments in Motion—W. C. Hitt and D. J. Hagemaier
Ultrasonic Inspection of Adhesive-Bonded Aluminum Sandwich Structures—C. C. Kammerer
An Ultrasonic Method to Detect, Count, and Measure Fluid-Contaminating Particles—C. P. Albertson
Ultrasonic Standards for the Evaluation of Missile Materials and Components—C. T. Adams and J. W. Morris

STP 278, 78 pages, hard cover, price $2.00, to members $1.60.

High-Voltage Cable Insulation

THE UTILITIES and cable manufacturers for some time have been contending with the necessity for transmission of power to satisfy an ever-increasing demand. This has resulted in higher and higher voltages for power cables—in excess of 300 kv. This symposium on high-voltage cable insulation brings together the views of experts in the cable field concerning the requirements for materials and for their proper application in cables. Emphasis is on test methods that will reveal the capabilities and shortcomings of insulation systems when used under extra-high-voltage conditions. Oil-impregnated paper continues to be the most satisfactory insulation for high-voltage cables, but requirements for materials are becoming more stringent.

The symposium was sponsored jointly by ASTM Committee D-27 on Electrical Insulating Liquids and Gases and the AIEE Insulated Conductors Subcommittee. The contents include:

Introduction—V. R. Mulhall
Paper for High-Voltage Cables—W. A. DelMar
The Why and How of Cable Oil Tests—A Review—R. B. Blodgett
The Utility Viewpoint on Cable Oils—A. M. Gates and R. W. Gillette.

STP 253, 39 pages, hard cover, price $1.50, to members $1.20.

Elevated Temperature Properties of Aluminum and Magnesium Alloys

THIS PUBLICATION, sponsored by the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals, summarizes elevated-temperature, tensile, and creep-rupture properties of current commercially established aluminum and magnesium alloys which would normally be used at elevated temperatures. The material included in this compilation constitutes elevated temperature data of the type used in determining allowable stresses for the Unfired Pressure Vessel Code of the ASME Boiler Code Committee. Also, every effort was made to cover those alloys used in the aircraft industry for elevated temperature applications. Both wrought and cast alloys are covered in various forms such as rolled, forged or extruded rod, plate, sheet, and castings, both sand and permanent mold; some data are given for alclad aluminum alloys.

The book is arranged for easy reference. A complete table of contents along with a comprehensive introduction help guide the reader to the presentation of the data. Title sheets for each alloy give the alloy designation, chemical composition, and the pertinent specifications under which various forms of the material are supplied. The Data Sheets for each alloy give a description of the material and the strength values for the mechanical properties. On the graphs, a consistent set of code symbols has been used, where practical, to distinguish types of products, test temperatures, and other variables.

STP 291, number of pages and prices to be announced.

Bituminous Waterproofing and Roofing Materials

SPECIALIZATION IS the rule in all fields of science, as in most other fields, and this applies to bituminous products as well. Producers in this field are not in direct touch with consumers, asphalt suppliers are in a

different world from coal-tar suppliers, and even consumer processors specialize in one type of product to the exclusion of the other.

This symposium volume attempts to inform and stimulate the interest of those concerned with waterproofing and roofing bitumens. Five of the eight papers are of a general nature and cover aspects of manufacture, inspection, applications, and service requirements of both asphalt and coal-tar materials and products. These papers will help the reader to a better understanding of some of the lesser known characteristics of bituminous materials.

Three of the papers are of specialized experimental or theoretical interest. The composition and rheology of roofing asphalt, which includes chemical change, stresses, thermal expansion and contraction, and ratio of surface to volume, are shown to have a definite effect upon service performance. Weatherability of coating-grade asphalts cannot be associated with the crude-oil source of the asphalt alone because of the effect of other added materials. A statistical study of weatherometer test data provides interesting conclusions on the best means of interpreting the results.

Use of glass fibers as a reinforcement for bitumens has been a part of the over-all development of reinforced plastics. This permits monolithic construction in both field-assembled built-up roofs and factory-produced prepared roofing materials. The papers in this STP are:

Composition and Rheology of Roofing Asphalt—A. B. Brown and J. W. Sparks
Some Qualitative Effects of Composition and Processing on Weatherability of Coating-Grade Asphalts—E. W. Mertens and S. H. Greenfeld
A Statistical Study of Weatherometer Data on Coating-Grade Asphalts—S. H. Greenfeld, W. E. Mertens, and P. W. John
Manufacture and Application of Asphalt Roofing—L. C. Haack
Asphaltic Grouts, Mastics, and Cold Applied Cements—W. L. Butterfield and Fred H. Haney
Glass-Fiber Felt Roofing Products—J. G. Hayes
Industrial Pitches—C. U. Pittman and J. W. Donegan
Coal-Tar Flat-Roof Pitch—W. F. Fair, Jr., J. and M. S. Chamberlain

STP 280, 81 pages, hard cover, price \$2.50, to members, \$2.00.

Steel Piping Materials

Compilation of Standards, A-1

THE 1960 EDITION of the compilation of ASTM Specifications for Steel Piping Materials will, as usual, be the handbook of American industry for the production, sale, and purchase of steel pipe, tubing, and accessory materials. First published in 1942, this compilation of selected ASTM standards has met with widespread acceptance in every one of its many editions.

The specifications in this compilation cover: (1) pipe used to convey liquids, vapors, and gases at normal and elevated temperatures, (2) still tubes for refinery service, (3) heat-exchanger and condenser tubes, and (4) boiler, superheater, and economizer tubes. To make the volume complete there are also included specifications for castings, forgings, and bolting and welding fittings used in such installations.

Many of the specifications in this compilation are incorporated in the ASME Boiler and Pressure Vessel Construction Code. A number have been approved as American Standard by the American Standards Assn.

Over half of the approximately 70 specifications included in the book have been revised since the 1959 edition was published. Many of the specifications for tubular products have been changed to include a more detailed description of the flattening test. Also provisions have been added for marking those tubular products not completely processed in accordance with the specification requirements. In the specifications for austenitic tubular products, marking requirements for various heat treatments have also been added.

ASTM Specifications for Steel Piping Materials, 536 pages, hard cover, price \$7.00, to members \$5.60.

1959 Proceedings

THE ASTM *Proceedings*, Vol. 59, 1959, became available in June and has been sent to all members who requested a copy. This 1400-page volume includes 71 reports of technical committees and 44 technical papers. Members are entitled to receive a copy of the *Proceedings* as part of their membership, the price of this volume to nonmembers being \$12. There are still a few copies available, so if any member neglected to send back the request blank for this book and still wishes to receive a copy, please write to Headquarters.

The same applies to the 1957 and 1958 editions. Some members may not have realized that there was a change made in the method of distribution, and that the *Proceedings* are now sent only on request.

1959 References on Fatigue

THIS LIST OF references consisting of about 460 entries provides an extensive source of information on articles published in 1959 dealing with fatigue of structures and materials. An abstract of each reference is included in all but a few cases. The material is so arranged that references can be cut apart for filing according to any desired plan. This publication is sponsored by the Subcommittee on Survey of ASTM Committee E-9 on Fatigue.

Similar lists of references were published covering the years 1950 through 1958. All these are available from ASTM Headquarters, singly, or in a package purchase with the current edition for \$18.00. Price of the 1959 edition alone is \$4.00.

STP 9-K, approximately 460 references, paper cover, price \$4.00.

X-Ray Powder Data File Expanded and Revised

LABORATORIES AROUND the world are availing themselves of these data for research applications and for identification of small amounts of unknowns.

The powder diffraction technique identifies each element or compound by its basic atomic structure. It is extremely useful in determining the state of combination of elements and the various constituents of mixtures of elements or compounds. The endeavor of the editors of the card file has been to supply reliable data as promptly as possible. The following four new publications of X-ray powder data have just been issued.

Section 10 of the X-Ray Powder Data Card File, Plain, Keysort and IBM, is another compilation of new data recorded on 879 cards. With Section 10 divided into an organic part and an inorganic part, it is possible to select either part if the purchaser's interest is specifically in either of these fields. The complete section furnishes data for all fields of research.

Revised Sections 1 to 5, X-Ray Powder Data. This is an entirely new idea, for these data have not only been revised and grouped into an organic and an inorganic part, but because of popular demand they have been published in both card and book form.

The Revised Sections 1 to 5, X-Ray Powder Data have been printed in plain and keysort cards; the IBM cards will be available at a later date. Sections 6 to 10 will also be revised and will follow the same form as the revised Sections 1 to 5, but this will not be possible for approximately five years. The work of revising the X-ray powder data and the publishing of these revised sections is considered only after the X-ray data in such sections have reached a stabilized point.

Revised Sections 1 to 5 in Book Form. Reproductions of the cards in these sections are made up in two volumes, one containing reproductions of the organic cards and the other, the inorganic cards. Three data cards are shown on each page with the card numbers appearing at the top of the page for easy identification.

This new book form is the result of public demand, not only for space saving and ease of handling, but also for reduction of cost.

Literature and price list will be sent upon request. Address X-Ray Department, ASTM Headquarters.

Index to the X-Ray Powder Data Card File

New Index Book, STP 48 I. With each new edition of the X-Ray Powder Data Card File a new edition of the Index Book is published. This is a cloth-bound volume of some 700 pages with groupings under the headings Numerical Section—Numerical Tables (showing the three strongest lines of each compound according to Hanawalt groupings), Alphabetical Section—Inorganic, Organic, Organic Formula, and Minerals (with other nonchemical names).

This new edition not only includes the data in the complete ten sections of the X-Ray Powder Data Card File but it also reflects the changes in the new publication of the Revised Sections 1 to 5 of the X-Ray Powder Data.

STP 48 I, 700 pages, approx., cloth-bound, price, **$12.00.**

TRAPPED ATOMS PROVIDE DATA ON FUNDAMENTAL CHEMICAL PROCESSES

The National Bureau of Standards has developed a method for trapping free radicals at temperatures near absolute zero. Here, nitrogen atoms, produced by a microwave discharge (center), are trapped on a 4.2-K surface (above), where they emit a characteristic blue glow. Twelfth ASTM Photographic Exhibit. Second prize, general class, color prints—technique. W. R. Smallwood, National Bureau of Standards, Washington, D. C.

OFFERS OF PAPERS FOR 1961

THE Administrative Committee on Papers and Publications will meet in early February to consider the papers to be published by the Society in 1961 and to develop the program for the Annual Meeting to be held in Atlantic City June 25–30.

All those who wish to offer papers for presentation at the meeting and publication by the Society should send these offers to Headquarters *not later than January 10, 1961.*

All offers should be accompanied by a summary that makes clear the intended scope of the paper and indicates features of the work that will, in the author's opinion, justify its publication and inclusion in the Annual Meeting program.

Suitable blanks for use in transmitting this information will be sent promptly upon request to Headquarters.

Industry Quickly Adopts New Structural Steel, A 36

EVEN BEFORE FINAL Society approval for publication was given on July 28, the new Tentative Specification for Structural Steel (A 36) was being discussed on a contractual basis by American industry. This steel now joins A 7 and A 373 steels as a stock item for steel mills and warehouses from coast to coast. Design stresses have been established and published by the American Institute of Steel Construction.

Whereas the guaranteed minimum yield point of A 7 steel is 33,000 psi, and that of A 373 steel is 32,000 psi, the guaranteed minimum yield point of A 36 steel is 36,000 psi. The increased cost of this steel is relatively less than the increased yield point obtained, so that economy will result in its use.

Some years ago, AISC suggested to ASTM Committee A-1 on Steel that the yield point of A 7 steel should be raised, but the proposal did not gain sufficient support. At the June, 1959, meeting of Subcommittee II on Structural Steel the subject was again raised. A task group was appointed to ask the American Institute of Steel Construction the American Association of State Highway Officials, the Association of American Railroads, and other groups whether they would use higher design stresses if a higher yield point were established. The replies indicated that it would not be advisible to change the requirements of A 7 steel, but much interest was evidenced in a higher-guaranteed-yield-point steel if economies would result.

The new A 36 steel has, in addition to the 36,000 psi guaranteed minimum yield, a tensile strength of 60,000 to 80,000 psi. The maximum carbon content is specified as 0.28 per cent ladle, 0.32 per cent check analysis. Additional requirements for manganese content are imposed for plates or bars over ¾ in. thick, and for plates over 1½ in. thick a silicon content is also specified.

ASTM Bulletin

No. 248 September 1960

Nineteen-Sixteen
Race Street
Philadelphia 3, Pa.

1961 Award of Merit Committee

THE 1961 AWARD of Merit Committee, appointed by the Board of Directors, includes J. S. Roberts and F. G. Tatnall, serving with holdover members G. D. Patterson, Jr., chairman, and J. H. Wolthorn. F. L. LaQue will represent the Board of Directors on the committee. In accordance with Rules Governing Award of Merit (p. 722, 1959 ASTM Year Book), all suggestions for 1961 Awards must be in the hands of the Executive Secretary of the Society for consideration by the Award of Merit Committee not later than February 1, 1961.

The Committee Officer

A WIDELY QUOTED expression attributed to one of our outstanding commanding generals of World War II is "Old soldiers never die, they just fade away." This year being an even-numbered year, we find many of our staunch and capable members retiring from office in the eighty-odd technical committees of the Society.

There is considerable prestige attached to being an officer of a technical committee. On the other hand, these officers are largely "unsung heroes," in view of their contributions to their committees, to the Society, and to the cause of standardization. The technical committees are the heart of the Society, and, correspondingly, the committee officers are the heart and mainspring of the committee.

Contrary to the quoted expression, our committee officers, when retiring from office, do not usually "fade away." In most cases they are still found amoung the ranks of the stalwarts in the committees, contributing their experience and assisting in the ever-continuing development of standards.

We wish here to pay homage and to give recognition to all committee officers, particularly those retiring from office at this time. The Staff is possibly more conscious of the contributions made by these men than is anyone else, owing to the close relationships established over the years. These relationships are probably the most valued and satisfying experiences that the staff has in connecton with its work.

This year the following are added to the "Roll of Honor of Retired Committee Officers":

Name, Office, and Committee	Years of Service[1]
H. L. Fry, secretary, A-1	6
T. E. Eagan, chairman, A-3	6
W. M. Albrecht, chairman, A-7	6
L. B. Fonda, secretary, A-10	2
B. W. Gonser, chairman, B-2	12
A. W. Tracy, secretary, B-3	20
L. H. Adam, secretary, B-5	4
I. V. Williams, chairman B-7	14
W. C. Voss, vice-chairman, C-7	18
L. J. Trostel, secretary, C-8	18
W. H. Price, chairman, C-9	6
R. E. Copeland, chairman, C-12	6
E. F. Wanner, 2nd vice-chairman, C-15	2
J. R. Bridgeman, assistant secretary, C-16	2
L. W. Currier, chairman, C-18	12
T. J. Pajak, chairman, C-19	6
J. H. Gibbud, secretary, C-19	2
M. D. Burdick, chairman, C-21	4
G. W. Phelps, secretary, C-21	6
A. R. Balden, chairman, C-23	3
E. W. Fasig, vice-chairman, D-1	18
W. A. Gloger, secretary, D-1	9
R. C. Alden, 1st vice-chairman, D-2	7
J. O. Izatt, 3rd vice-chairman, D-4	6
J. M. Griffith, secretary, D-4	6
O. W. Rees, chairman, D-5	4
R. H. Carter, chairman, D-6	10
L. W. Wood, vice chairman, D-7	2
G. W. Robbins, secretary, D-8	11
H. K. Graves, chairman, D-9	5
J. G. Turk, chairman, D-10	2
B. L. Whittier, chairman, D-13	4
A. G. Scroggie, 1st vice-chairman, D-13	16
Rudy K. Worner, 2nd vice-chairman, D-13	2
J. J. Lamb, secretary, D-14	4
W. W. Sederlund, membership secretary, D-14	4
C. O. Durbin, secretary, D-15	3
E. J. Kilcawley, chairman, D-18	18
W. S. Housel, 1st vice-chairman, D-18	16
F. J. Converse, 2nd vice-chairman, D-18	13
F. W. Reinhart, chairman, D-20	8
A. C. Webber, 1st vice-chairman, D-20	4
R. M. Berg, secretary, D-20	2
R. H. Carey, membership secretary, D-20	4
L. Silverman, chairman, D-22	2
H. W. Shader, chairman, D-25	4
V. E. Amspacher, chairman, D-26	2
F. M. Clark, chairman, D-27	3
D. E. Parsons, vice-chairman, E-1	2
D. L. Fry, chairman, E-2	4
Cyrus Feldman, secretary, E-2	6
W. J. Krefeld, chairman, E-5	10
Harold Perrine, vice-chairman, E-6	6
R. A. Biggs, secretary, E-6	9
R. E. Peterson, chairman, E-9	14
O. J. Horger, secretary, E-9	14
W. T. Lankford, assistant secretary, E-9	2
O. P. Beckwith, secretary, E-11	14
R. S. Hunter, secretary, E-12	6
R. A. Friedel, chairman, E-14	4
R. A. Brown, secretary, E-14	2
Stanton Umbreit, secretary, F-1	11
T. M. Hill, secretary, F-2	3
B. W. Gonser, chairman, ACR	6

L. C. G.

[1] Total number of years as a committee officer.

To Our Latin American Colleagues and Their North American Friends:

THE 25TH ANNIVERSARY celebration of the Instituto Argentino de Racionalizacion de Materiales (IRAM), mentioned elsewhere in this BULLETIN, points up the interest in standardization in Latin America. IRAM has been working in this field a great number of years and has a very effective standardization procedure. The same is true in other Latin American countries.

The ASTM has exchange relations with many of them. It has been suggested that even more effective cooperative participation in the development of standards is desirable. We understand that, in the case of IRAM, and possibly elsewhere, comments on proposed standards would be appreciated while these are still in the formative stage. Those North American companies doing business in South America might well wish to take advantage of the opportunity to review these standards

while they are still being developed.

We should like to hear from any of our members who wish to be kept informed of standards that are under consideration in IRAM or in any of the other standardization agencies. We should also like to hear from any companies or individuals who would be interested in seeing ASTM standards translated into Spanish or Portuguese. Possibly a number of organizations have already made such translations for their own use, in which case we should like to know about it.

Any information such as this should be conducive to better relations between the people of our several countries, and that is what we are all striving for. R.E.H.

MATERIAL QUESTIONS

NEARLY EVERY day the mail at ASTM Headquarters includes some questions about materials, specifications, test methods, or related problems. We feel that the answers, many of which are based on information given us by officers of committees in their capacity as committee officers, are of general interest. For the most part, inquiries we receive are related to the activities of the Society, either standards, research work, or publications. Often, an inquiry is such that the services of a consultant or independent testing or research laboratory is obviously required; in this event we do not hesitate to so recommend.

Cass and Corrodkote Tests

Where can information be had as to the procedures for the Cass and Corrodkote laboratory corrosion tests used for plated coatings?

● These tests were developed in the American Electroplaters' Society and are now being taken up by Committee B-3 on Corrosion of Non-ferrous Metals and Alloys. The Cass test, a copper accelerated acetic acid salt spray test, is discussed by G. L. Sukes, in *Metal Finishing*, Vol. 57, No. 12, p. 59, Dec., 1959; by N. F. Nixon *et al*, in *Technical Proceedings*, Am. Electroplaters Soc., p. 159 (1959); and in General Motors Laboratory Procedure GM 4476-P. The Corrodkote test, a copper salt spray clay-pack humidity test, is discussed by W. L. Pinner, in *Plating*, Vol. 44, No. 6, p 763, June, 1957; D. M. Bigge, *Technical Proceedings*, Am. Electroplaters' Soc., p. 149 (1959); and Chrysler Laboratory Procedure No. 461H-85.

Glass Bottles for Bacteriology

Does ASTM publish methods that can be used to determine the suitability of glass bottles for bacteriological use?

● Sections 8 to 12 of Method C 225 define the determination of alkali solubility of glass containers. The alkali dissolved from the glass container by aqueous solutions is an essential limiting factor in soda-lime glass bottles for bacteriological use.

Schedule of ASTM Meetings

This gives the lastest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

Date	Group	Place
Oct. 3-6	Committee D-20 on Plastics	Detroit, Mich. (Sheraton-Cadillac Hotel)
Oct. 4-5	Committee D-10 on Shipping Containers	Ft. Belvoir, Va.
Oct. 4-5	Committee C-19 on Structural Sandwich Constructions	Philadelphia, Pa. (Headquarters)
Oct. 5-6	Committee C-8 on Refractories	Bedford, Pa. (Bedford Springs Hotel)
Oct. 5-7	Committee D-9 on Electrical Insulating Materials	Detroit, Mich. (Sheraton-Cadillac Hotel)
Oct. 6	Committee C-20 on Acoustical Materials	Philadelphia, Pa. (Headquarters)
Oct. 9	Committee D-3 on Gaseous Fuels	Atlantic City, N. J. (Shelburne)
Oct. 9-13	Committee D-2 on Petroleum Products and Lubricants	Washington, D. C. (Mayflower Hotel)
Oct. 12	Committee C-14 on Glass and Glass Products	Bedford, Pa. (Bedford Springs Hotel)
Oct. 12	Organization Meeting of E-18 on Sensory Testing	Philadelphia, Pa. (Headquarters)
Oct. 13-14	Committee D-14 on Adhesives	Chicago, Ill. (Del Prado Motel)
Oct. 17-18	Committee B-9 on Metal Powders and Metal Powder Products	Philadelphia, Pa. (Headquarters)
Oct. 17-19	Committee C-13 on Concrete Pipe	Chicago, Ill. (Union League)
Oct. 18-21	Committee D-13 on Textile Materials	New York, N. Y. (Sheraton-McAlpin Hotel)
Oct. 19-21	Committee B-8 on Electrodeposited Metallic Coatings	Philadelphia, Pa. (Benj. Franklin Hotel)
Oct. 20-21	Committee C-3 on Chemical Resistant Mortars	Suffern, N. Y. (Motel on the Mountain)
Oct. 24-25	Committee B-1 on Wires for Electrical Conductors	Washington, D. C. (Mayflower Hotel)
Oct. 27	New England District	Boston, Mass.
Oct. 31-Nov. 2	Rocky Mountain District (joint with American Concrete Inst.)	Tucson, Ariz.
Nov. 1-2	Committee B-4 on Metallic Materials for Thermostats and for Electrica lResistance, Heating, and Thermostats	Skytop, Pa. (Skytop Lodge)
Nov. 3	Committee F-2 on Flexible Barrier Materials	New York, N. Y. (Statler Hotel)
Nov. 3-4	Committee F-1 on Materials for Electron Tubes and Semiconductor Devices	Skytop, Pa. (Skytop Lodge)
Nov. 3-4	Committee D-27 on Electrical Insulating Liquids and Gases	Williamsburg, Va.

Standard Metal-Organic Samples Now Offered by NBS

FOR MANY YEARS chemists in the petroleum industry have needed accurate standard samples for determining metals in petroleum products. From the spectrographic determination of the metals that accumulate in crankcase oils, engineers can judge engine wear. Periodic analyses of oil from diesel locomotive engines are now made by several railroads to detect faulty bearings. Determination of metals in petroleum products is also important in refining processes and in the use and control of materials added to oils to improve lubricating properties.

Such analyses require standard samples containing known quantities of the metallic elements in question. A set of 24 standard metal-organic samples, suitable for spectrographic and chemical analysis of petroleum products, is now available from the National Bureau of Standards. These crystalline, oil-soluble samples are distributed with a certificate of analysis and directions for preparing solutions. The price is $6.00 per 5 g of material.

1960 PHOTOGRAPHIC EXHIBIT PRIZES

General Class

Black and White—Materials

FIRST PRIZE: Not awarded.
SECOND PRIZE: *Improved Nails*, E. George Stern, Virginia Polytechnic Inst., Blacksburg, Va.
THIRD PRIZE: *A Wooden Stare*, M. W. Girard, American Bitumuls and Asphalt Co., Emeryville, Calif.
HONORABLE MENTION: *Surface Wear of Cap-Bearing*, Daniel R. Condon, United States Testing Co., Inc., Hoboken, N. J.

Black and White—Technique

FIRST PRIZE: *Compression Failure of Block Wall Built in Vertical Stacked Bond*, William H. Kuenning, Portland Cement Assn., Skokie, Ill.
SECOND PRIZE: *20th Dynamic Median Barrier Crash Test, Peak of Action During Test*, Robert M. Souza, Dept. of Public Works, Division of Highways, Sacramento, Calif.
THIRD PRIZE: *Fabrication Under Inert Atmosphere*, D. J. Reitmeyer, Universal Cyclops Steel Corp., Bridgeville, Pa.
HONORABLE MENTION: *Pressure Application of a Polysulfide Seal on a Mullion*, Bernard M. Berns, *Adhesives Age*, New York, N. Y.

Color Prints—Materials

FIRST PRIZE: *Carpet Colors*, Daniel R. Condon, United States Testing Co., Hoboken, N. J.
SECOND PRIZE: *Synthetic Quartz Crystal*, Marjorie R. Ashe, Clevite Corp., Cleveland, Ohio.
THIRD PRIZE: *Fungus Growth on Electrical Capacitor Inoculated with Mixed Fungus*, J. Normand, Pitman-Dunn Laboratories, Frankford Arsenal, Philadelphia, Pa.
HONORABLE MENTION: *Fungus Growth on Rubber Component of Radar Fuze Test Set*, J. Normand, Pitman-Dunn Laboratories, Frankford Arsenal, Philadelphia, Pa.

Color Prints—Technique

FIRST PRIZE: *Endless Wear*, Daniel R. Condon, U. S. Testing Co., Hoboken, N. J.
SECOND PRIZE: *Trapped Atoms Provide Data on Fundamental Chemical Processes*, William R. Smallwood, National Bureau of Standards, Washington, D. C.
THIRD PRIZE: *The Boot*, Daniel R. Condon, U. S. Testing Co., Hoboken, N. J.
HONORABLE MENTION: *Doll Inspection*, Daniel R. Condon, U. S. Testing Co., Hoboken, N. J.
HONORABLE MENTION: *Casting an Experimental Steel*, R. H. Sozanski, U. S. Steel Corp., Monroeville, Pa.
HONORABLE MENTION: *Research on Oxygen in Steel Making*, E. W. Sherwin and E. M. Vrabel, U. S. Steel Corp., Monroeville, Pa.

Color Transparencies

FIRST PRIZE: *Ion Flame Photograph*, Everett J. Nieuwenhuis, (former employee) Texaco Experiments, Inc., Richmond, Va.
HONORABLE MENTION: *Cobalt-60 Source Showing Cherenkov Radiation*, L. D. Burg, Texaco, Inc., Beacon, N. Y.
HONORABLE MENTION: *Formation of the Failing Crack*, A. E. Carden, Bureau of Engineering Research, University of Alabama.

Photomicrographs

Black and White—Technique

FIRST PRIZE: *Pyrolytic Graphite, Vapor Deposited onto a Graphitized Coke Base, Polarized Light*, Norman J. Gendron, General Electric Co., Schenectady, N. Y.
SECOND PRIZE: *Photomicrographic Technique Shows the Layers of Insulation on Magnet Wire*, Daniel M. Trollinger, General Electric Co., Louisville, Ky.
THIRD PRIZE: *Polycrystalline Alumina*, W. A. Roman, General Electric Co., Schenectady, N. Y.
HONORABLE MENTION: *Use of "Temper-Brittleness" Etchant Permits Austenitic Grain Size Measurement of Cr-Mo-V Alloy Steels*, James Nelson, Westinghouse Electric Corp., East Pittsburgh, Pa.

Black and White—Materials

FIRST PRIZE: *Twinning in As-Cast Silicon*, Mrs. T. V. Brassard, General Electric Co., Schenectady, N. Y.
SECOND PRIZE: *ZnSb-Sb Eutectic*, R. D. Buchheit, J. L. McCall, and G. A. Wheeler, Battelle Memorial Inst., Columbus, Ohio.
THIRD PRIZE: *Forming Failure Resulting from Anneal Below Upper Critical Temperature*, Charles H. Monroe, The Detroit Testing Co., Detroit, Mich.
HONORABLE MENTION: *Weeping Interface*, James Nelson, Westinghouse Electric Corp., East Pittsburgh, Pa.
HONORABLE MENTION: *Pyrolytic Graphite, Vapor Deposited onto a Graphitized Coke Base, Polarized Light*, Norman J. Gendron, General Electric Co., Schenectady, N. Y.
HONORABLE MENTION: *Structure Study of Flame Hardened Cast Iron Way*, Charles H. Monroe, The Detroit Testing Laboratory, Detroit, Mich.
HONORABLE MENTION: *Single Crystal of Lead Showing Elongated Cells and Growth Terraces on the Solid-Liquid Interface*, R. R. Russell, General Electric Co., Schenectady, N. Y.
HONORABLE MENTION: *Titanium Diboride-A —Uncontrolled Crystal Growth*, G. L. Peters, National Carbon Co., Fostoria, Ohio.

(Continued on page 18)

Papers to Appear in Future Issues of the ASTM Bulletin

Punch Card Handling of Atmospheric Test Data—W. H. Ailor and M. R. Hodgson, Reynolds Metals Co.
Flexural and Impact Variations of Phenolic Moldings: A Statistical Round-Robin Study—C. Elmer and E. C. Harrington, Jr., Monsanto Chemical Co.
Low-Temperature Tensile-Hardness Correlations of SAE 4340 Steel—J. Nunes and F. R. Larson, Watertown Arsenal Laboratories.
Moisture Penetration of Brick Masonry Panels—T. Ritchie and W. G. Plewes, National Research Council of Canada.
A High-Temperature, Vacuum, Axial Fatigue Testing Machine—R. I. Stephens and G. M. Sinclair, University of Illinois.
Water Permeability Studies on Latex and Latex Paint Film—R. C. Simon, The Dow Chemical Co.
Lightfastness Testing of Pigment Colors—W. F. Spengeman and G. Wormald, E. I. du Pont de Nemours & Co., Inc.
Determination of the Thermal Stability of Disiloxane Base Hydraulic Fluids—Myra Willard, Hughes Aircraft Co.

Three DOD Contracts Awarded for Basic Materials Research

BASIC RESEARCH in materials has received a $13.9 million boost from the Advanced Research Projects Agency, and more is to come. Lack of adequate materials is slowing the development of many new weapons, and ARPA hopes by this means to help provide the new materials that are needed.

The funds will be divided among three universities, Cornell, Northwestern and University of Pennsylvania, who will use the money to set up and operate interdisciplinary laboratories to study "the fundamental relationships which exist between composition and structure and the properties and behavior of materials." Work will be in such fields as metallurgy, ceramic science, solid-state physics, chemistry, solid-state mechanics, surface phenomena, and polymer sciences. ARPA plans to let similar contracts to additional schools in the future.

British Journal Begins New Indexing Service

THE IRON and Steel Institute (Great Britain) is starting an abstract and book title index card service which will consist of index cards containing the abstracts and new book titles as published in the *Journal* of The Iron and Steel Institute. The service will be in the form of 3 by 5-in. cards which will be sent to subscribers fortnightly in advance of their publication in the *Journal*. Details of the index card service and the price of subscription may be obtained by writing the Secretary, The Iron and Steel Institute, 4 Grosvenor Gardens, London, S. W. 1, England.

Concrete Pavement Symposium to Be Held in Buenos Aires

A SYMPOSIUM on Concrete Pavements will be held in Buenos Aires, Argentina, Nov. 21–26, 1960. It is being sponsored by Argentine governmental and private agencies in the airport and highway construction fields. Although the symposium was prompted, in part, by a national plan for highway and airport development in Argentina, it is hoped that the sessions will be international in character. Engineers from other countries are invited to attend or to take part in the sessions. Further information can be obtained from Juan F. Garcia Balado, president, or Raul A. Colombo, secretary general, Symposium on Concrete Pavements, Calle San Martin 1137, Buenos Aires.

One Answer to the Engineer Shortage

AN EXAMPLE OF THE forward look in engineering education on the vocational-high school level is a course outline entitled "Construction Engineering Aide" now being offered at the T. H. Harris Vocational-Technical School, in Opelousas, La.

This is of especial interest to ASTM and particularly to the Administrative Committee on Education in Materials. In addition to a well-rounded list of subjects in mechanical drawing, mathematics, mechanics, estimating, business communications, and industrial relations, the course includes a group of subjects based on materials and methods of construction. With these subjects are also found the study of engineering contracts and specifications, a practical course in concrete (including field control, sampling, and testing), and a comprehensive coverage of soil and foundation testing.

This type of training is one answer to the problem of providing a source of well-trained engineering aides for many types of routine tasks which do not necessarily require a college graduate.

Conference on Magnetism

THE SIXTH Annual Conference on Magnetism and Magnetic Materials will be held in New York City, November 14-17, at the New Yorker Hotel. This conference is sponsored jointly by the American Institute of Electrical Engineers and the American Institute of Physics, in cooperation with the Office of Naval Research, the Institute of Radio Engineers, and the Metallurgical Society of AIME.

Typographical Errors in ASTM-IP Petroleum Measurement Tables American Edition--1952

ATTENTION IS CALLED to the following four typographical errors in Table VI of the ASTM-IP Petroleum Measurement Tables, American Edition, 1952.

Page	Gravity at 60 F	Observed Temperature, deg. F	Factor for Reducing Volume to 60 F	
			Change	To Read
66	18	27	1.1029	1.0129
74	22	147	0.0659	0.9659
74	23	147	0.0656	0.9656
79	33	139	0.0656	0.9656

Members having copies of the American Edition and the separate reprint of Table VI will undoubtedly wish to note these corrections in their copies.

Prospectus Outlines Need for Metrology Center

A JOINT task force of representatives of the National Bureau of Standards and the George Washington University, Washington, D. C., has developed a prospectus for a Center for Metrology. This activity was prompted by repeated requests from industrial organizations and government agencies for assistance in handling measurement problems. The prospectus, which may be had on request, describes the background of the needs that have developed in recent years and are now critical for improvement and expansion of precision calibration facilities and for personnel to staff them. It continues with a plan for establishing a center for metrology at the George Washington University as part of its school of engineering, with collaboration and support of industry and government.

Copies of the prospectus may be obtained by writing Dean Martin A. Mason, School of Engineering, the George Washington University, Washington 6, D. C.

25th Anniversary of IRAM

ON MAY 2, the Instituto Argentino de Racionalizacion de Materiales (IRAM), the Argentine Standards Society, reached its 25th anniversary. Congratulations and best wishes on this event have been transmitted in behalf of ASTM, which has been in quite close touch regularly with this active Argentine institute.

Descriptions of the work of IRAM have appeared in the ASTM BULLETIN, and an exchange membership is in effect.

We were sorry to learn through IRAM's director general, Ing. Beatriz Ghirelli de Ciaburri, of the death in April of IRAM's long-time president, Vice-Admiral Stewart. He was 79 years of age and had been president and very active in IRAM for the past 15 years.

Because of Admiral Stewart's death, IRAM is deferring the special issue of its magazine, *Informaciones IRAM*, but in September plans to commemorate its 25th Anniversary.

Argonne National Laboratory Sponsoring Symposium on Physics and Nondestructive Testing

A TWO-DAY SYMPOSIUM, "Physics and Nondestructive Testing," will be held at the Argonne National Laboratory, Argonne, Ill., Oct. 4 and 5, 1960.

This symposium will concentrate on nondestructive methods of evaluating materials properties and the knowledge in those branches of physics which form the basis of such methods. The symposium will be concerned with any physical research that might be adapted to the determination of materials properties by nondestructive testing, with emphasis on physical principles rather than on application.

The program will include invited papers on neutron diffraction, elastic-wave propagation, mode conversion, Lamb waves, accelerators, neutron radiography, solid-state detectors, ultrasonic attenuation, pulsed-field eddy currents, and applications of mathematics to nondestructive materials evaluation.

The technical part of the program is being arranged by the Nondestructive Testing Group of the Metallurgy Division of Argonne National Laboratory. This will be an unclassified meeting, and any person interested in the evaluation of material properties using nondestructive methods is invited to attend. Further information can be obtained from the program chairman, W. J. McGonnagle, Argonne National Laboratory, 9700 South Cass Ave., Argonne, Ill. The tentative program:

Session I. 9:15 a.m. to 1:00 p.m., Oct. 4

Neutron Diffraction—S. S. Sidhu, Argonne National Laboratory

Neutron Radiography—Harold Berger, Argonne National Laboratory

Solid-State Detectors—J. Gilroy, Argonne National Laboratory

Session II. 2:00 p.m. to 5:00 p.m., Oct. 4

Wave Velocities in Nonhomogeneous Elastic Media—W. S. Jardetzky, Manhattan College

Mode Conversion—Sperry Products

Lamb Waves:

Theory—Miss R. A. di Novi, Argonne National Laboratory

Experimental—D. C. Worlton, Hanford Atomic Products Operation

Dinner—Mr. Kunio Ono, Speaker

Session III. 9:00 a.m. to 12:30 p.m., Oct. 5

Ultrasonic Attenuation—R. S. Truell, Brown Univ.

Pulsed-Field Eddy Currents—C. J. Renken, Argonne National Laboratory

Magnetism in Nuclear Materials—M. V. Nevitt, Argonne National Laboratory

Session IV. 1:30 p.m. to 4:30 p.m., Oct. 5

Mathematics in Nondestructive Testing—W. Miller, Argonne National Laboratory

Statistical Methods in Nondestructive Testing—J. W. Butler, Argonne National Laboratory

Accelerator Physics—A. Burrill, High Voltage Engineering Co.

ACR Notes

Administrative Committee on Research

The Pendulum Swings On

F. T. SISCO[1]

SIXTY YEARS AGO the science of metallurgy, which deals with fundamental principles and reactions underlying the extraction of metals from their ores, with their preparation for use, and with their properties, was in its infancy. At the turn of this century graduate metallurgists were unique individuals. If these early metallurgists were college-trained at all, they usually had baccalaureate degrees in chemistry or mechanical engineering. This was neither strange nor startling; in the years preceding World War I metallurgical courses in this country's colleges and universities consisted of limited instruction in connection with curricula in mining engineering, chemistry or chemical engineering, mechanical engineering, and, in a few isolated instances, physics.

Consequently these early metallurgists approached metallurgy from diametrically opposite viewpoints. The chemist was interested in the reactions involved in getting metals out of their ores, in refining them until they were of satisfactory purity, and in alloying, working, and otherwise treating them so that they could be used effectively and economically for the innumerable products desired by a rapidly progressing and luxury-loving civilization. The mechanical engineer was interested in metals primarily from the standpoint of their properties and suitability for the structures, machines, and other end products he was designing and constructing.

From these two opposite poles the science of metallurgy evolved rapidly, both centripetally and centrifugally, until now it is a comprehensive and complex discipline. Basically it still rests predominantly on chemical reactions and engineering properties, but it has appropriated for its own use a number of areas that have long been an accepted part of physics, with the result that we now have not only chemical metallurgy and mechanical metallurgy but physical metallurgy or, to use a more modern term, the physics of metals. In fact the modern science of metallurgy is so complex that we now need a philosophy of metallurgy to tie the loose ends together into a coherent and logical whole.

But the pendulum swings on. The physics of metals has progressed so far in discovering and applying the fundamental principles underlying the structural and physical behavior of metals that these basic principles are being extended to cover materials other than metals. Witness the ferment now being aroused in academic circles by a cooperative study by the American Society for Engineering Education and other professional groups of the concept that materials engineering can and should be considered as an extension of metallurgical engineering. Witness the recent formation of a metallurgical-ceramic foundation by the American Ceramic Society, the Metallurgical Society of AIME, and the American Society for Metals.

Witness also the character of the papers now being presented at meetings of metallurgical societies. For example, the symposium on space vehicles held last April at the AIME Metals and Materials Conference at Los Angeles had papers on the effect of environment on space materials, material problems in space-vehicle engine development, and material problems in temperature control of space vehicles, to name only part of the program. And finally, witness the program of the two-day conference to be held by the Metallurgical Society of AIME at Estes Park, Colo., in July of this year on the response of materials to high-velocity deformation.

These are more than straws in the wind. A comprehensive and complex science of metallurgy has evolved in approximately fifty years from certain areas in chemistry, physics, and mechanical engineering that deal with metals, and there are definite indications that it is now reaching out further to include materials other than metals. This is good—a dynamic science must expand, or it will stagnate—but it raises a question. If professional societies that for years have restricted their field of interest to the sciences concerned with metallic materials can expand to include nonmetallic materials, why shouldn't the American Society for Testing Materials take a commanding lead in this expansion? It should; for 60 years and more its *modus operandi* has been to provide reliable standards in the entire field of materials; its membership includes a cross-section of the foremost experts in all industrial materials; and its recently established Division of Materials Sciences is a perfect organization for providing this leadership.

I am sure that I voice the feeling of the entire ASTM Administrative Committee on Research in expressing the hope that the Division of Materials Sciences will soon become the leader in making a science of materials as important a branch of engineering as the science of metals is today.

[1] Director, Alloys of Iron Research.

1960 Photographic Exhibit Prizes

(*Continued from page 16*)

HONORABLE MENTION: *Inhibition of Recrystallization in Superpure Aluminum by Helium*, Carl James Scully, Atomic Energy of Canada, Ltd., Chalk River, Ont.

Color—Non-Metals

FIRST PRIZE: *Cross-dyed Sections of Rayons Showing "Skin" and "Core" Relationships*, Mrs. Virginia Johnson, Philip Morris, Inc., Richmond, Va.

SECOND PRIZE: *Structure of Used Chrome Ore-Periclase Brick*, N. B. Dodge and R. H. Mills, U. S. Steel Corp., Monroeville, Pa.

THIRD PRIZE: *Olivine Crystals in Dunite Rock—Same Area, Polarized Light*, N. B. Dodge and R. H. Mills, U. S. Steel Corp., Monroeville, Pa.

HONORABLE MENTION: *Porcupine Ball of Secondary Calciumsulfoaluminate in Concrete*, Bernard Erlin, Portland Cement Assn., Skokie, Ill.

Color Particles—Metallic

FIRST PRIZE: *Aluminum Coated Fiberglass in Aluminum Powder Matrix*, Marjorie R. Ashe, Clevite Corp., Cleveland, Ohio.

SECOND PRIZE: *Second Phase of Yttrium Tetraboride in Yttrium Hexaboride*, Donald R. Lewis, General Electric Co., Pleasanton, Calif.

THIRD PRIZE: *Lamella Structure of a Polycrystalline Bismuth Telluride Semiconductor Material*, Frederick E. Barrows, Metals and Controls Div., Texas Instruments, Inc., Attleboro, Mass.

HONORABLE MENTION: *Twinning in High Purity Silver Selinide (Ag_2Se) as Revealed by Polarized Light*, Mrs. T. V. Brassard and R. R. Russell, General Electric Co., Schenectady, N. Y.

HONORABLE MENTION: *Aluminum Coating on Steel*, A. G. Lees and W. O. Schaffnit, U. S. Steel Corp., Monroeville, Pa.

Color—Metals

FIRST PRIZE: *18 Cr-8 Ni Stainless Steel at 2050 F*, James S. Makris, Westinghouse Atomic Power Dept., Pittsburgh, Pa.

SECOND PRIZE: *Micro-Tensile Test of an Aluminum Oxide Whisker at 2000 C*, R. R. Russell, General Electric Co., Schenectady, N. Y.

(*Continued on page 94*)

District Activities

ROCKY MOUNTAIN

Concrete Research Problems to Be Discussed Jointly with ACI

A joint ACI-ASTM research session will highlight the 13th Regional Meeting of the American Concrete Inst. to be held jointly with a meeting of the Rocky Mountain District of ASTM at the Pioneer Hotel, Tucson, Ariz., October 31 to November 2, 1960.

ACI technical committee meetings and technical sessions on construction and research in design are scheduled for the first two days. On Wednesday morning, November 2, members of ASTM and ACI will meet separately to discuss research and design problems, respectively. The two groups will meet together in the afternoon for a joint research session. The Wednesday luncheon will be addressed by ASTM President A. Allan Bates, who is also a director of ACI.

Coming District Meetings

District	Place	Date	Program
Central New York	Corning, N. Y.	October 10	Undetermined
New England	Boston, Mass.	October 27	Automation Panel
St. Louis	St. Louis, Mo.	October 27	R. W. Seniff
Rocky Mountain	Tucson, Ariz.	October 27	A. A. Bates
Philadelphia	Newark, Del.	November 9	A. A. Bates

International Association for Shell Structures Formed

THE SUCCESS OF A symposium on Nonconventional Processes of Construction, which was held in Madrid in September, 1959, coupled with the large number of subsequent inquiries, has resulted in the formation of the International Association for Shell Structures. The purpose of IASS is to foster activity in this technology, to facilitate the interchange of ideas, and to publish findings in appropriate journals.

A colloquium on "Precast Shells" is planned for this fall, probably in Warsaw or Dresden. "Experimental Research on Shell Structures" will be the subject of a meeting scheduled for September, 1961, in Delft, Holland. A third meeting, on "Approximate Methods of Calculation," is to be held in Brussels.

The IASS will deal not only with reinforced concrete shells but also with other materials, such as reinforced ceramics, metals, wood, plastics, when they form a continuous surface, and also when a plane structure consists of triangulations or cables, such as hanging walls.

Activities of the new association will be organized by an Executive Council, a third of which will be renewed every two years. The present U. S. member of the council is A. L. Parme, vice-president of IASS.

To apply for membership or to obtain more detailed information, write to: Secretariat of the International Association for Shell Structures, Alfonso XII, 3, Madrid (7), Spain.

Army's First Reactor Dedicated to H. H. Lester

THE FIRST NUCLEAR reactor to be provided for the Army was dedicated, on May 17, 1960, to the memory of Horace Hardy Lester, in a ceremony held at Watertown Arsenal, Watertown, Mass. Built at a cost of more than a million dollars, the reactor will be used by the Army for materials research.

Dr. Lester was chief scientist at the arsenal from 1922 to 1953, and consultant, Ordnance Materials Research Office, from 1953 until his death in 1955. He was nationally recognized as a pioneer in the field of industrial radiography and contributed a lifetime of effort to the establishment and growth of basic research at Watertown Arsenal. He initiated and promoted the nuclear reactor project. Long active in ASTM, Dr. Lester contributed much to the work of Committees E-4 on Metallography, E-7 on Nondestructive Testing, and the Administrative Committee on Research. He received the Award of Merit in 1951, and Honorary Membership in 1953. He was for four years chairman of the New England District Council.

Guests at the dedication were addressed by Brig. Gen. C. E. Rust, commanding general, Watertown Arsenal; Maj. Gen. August Schomburg, commanding general, U. S. Army Ordnance Missile Command; and Massachusetts Congresswoman Edith Nourse Rogers. ASTM was officially represented at the dedication by Vice-President Miles N. Clair.

ACDA Recommends New District

AT A MEETING held during the 63rd Annual Meeting, the Administrative Committee on District Activities recommended to the Board of Directors the formation of a Northwest District to include Oregon, Washington, Idaho, and British Columbia. When formed, the Northwest will be the 18th ASTM District. Also recommended to the Board was a change of the St. Louis District name to the Mississippi Valley District, so that the new name might be more representative of the area served.

Some of the present problems associated with district administration are rooted in past practices, which are not easily applied to current circumstances. Recognizing this, the ACDA has formed a subcommittee to study and revise the current District Charter and Manual of Operation. It is hoped that a revised edition will be available within a year. Mr. G. H. Harnden, former Director of the Society, is chairman of this subcommittee.

Another new subcommittee will study current district boundaries and also the formation of new districts. It will be under the chairmanship of Mr. L. A. O'Leary, Director of the Society.

The ACDA once again sponsored its annual breakfast meeting of district officers at the 63rd Annual Meeting. The breakfast proved a fruitful forum for the exchange of ideas concerning district programs and administration. District officers and councilors were urged to communicate with Mr. Miles Clair, chairman of ACDA, regarding any problems or suggestions.

Technical Committee Officers

Listed below are chairman and secretaries of all ASTM technical committees. The 1960 ASTM Year Book will contain complete lists of officers and personnel of the various committees. The asterisk indicates new officers.

Committee	Chairman	Secretary
A-1 on Steel	J. J. Kanter, Crane Co., Chicago, Ill.	*W. S. Scott, Republic Steel Corp., Cleveland, Ohio
A-2 on Wrought Iron	L. S. Crane, Southern Railway System, Washington, D. C.	O. M. Tishlarich, A. M. Byers Co., Pittsburgh, Pa.
A-3 on Cast Iron	*R. A. Clark, Union Carbide Metals Co., Cleveland, Ohio	*C. F. Walton, Gray Iron Founders' Society, Inc., Cleveland, Ohio
A-5 on Corrosion of Iron and Steel	H. F. Hormann, Consolidated Edison Co. of New York, Inc., New York, N. Y.	C. P. Larrabee, United States Steel Corp., Monroeville, Pa.
A-6 on Magnetic Properties	A. C. Beiler, Westinghouse Electric Corp., Pittsburgh, Pa.	W. S. Eberly, Carpenter Steel Co., Reading, Pa.
A-7 on Malleable Iron Castings	*C. F. Joseph, 1620 W. Delta Dr., Saginaw, Mich.	J. H. Lansing, Shaker Heights, Ohio
A-9 on Ferro Alloys	S. W. Poole, Republic Steel Corp., Canton, Ohio	W. H. Mayo, United States Steel Corp., Pittsburgh, Pa.
A-10 on Iron-Chromium Iron-Chromium-Nickel and Related Alloys	L. L. Wyman, National Bureau of Standards, Washington, D. C.	*G. R. Woodrow, G. O. Carlson, Inc., Thorndale, Pa.
B-1 on Wires for Electrical Conductors	D. Halloran, Consolidated Edison Co. of New York, Inc., New York, N. Y.	A. A. Jones, Anaconda Wire and Cable Co., Hastings-on-Hudson, N. Y.
B-2 on Non-Ferrous Metals and Alloys	*Alfred Bornemann, Stevens Institute of Technology, Hoboken, N. J.	*C. K. Conrad, American Metal Climax, Inc., New York, N. Y.
B-3 on Corrosion of Non-Ferrous Metals and Alloys	K. G. Compton, Bell Telephone Laboratories, Inc., Murray Hill, N. J.	*W. H. Ailor, Reynolds Metals Co., Richmond, Va.
B-4 on Metallic Materials for Thermostats and for Electrical Resistance, Heating, and Contacts	E. I. Shobert, II, Stackpole Carbon Co., St. Marys, Pa.	C. K. Strobel, Westinghouse Electric Corp., Pittsburgh, Pa.
B-5 on Copper and Copper Alloys	W. H. Jennings, Western Electric Co., Inc., Chicago, Ill.	*G. C. Mutch, Revere Copper & Brass, Inc., Rome, N. Y.
B-6 on Die-Cast Metals and Alloys	W. Babington, Bell Telephone Laboratories, Inc., Murray Hill, N. J.	G. L. Werley, The New Jersey Zinc Co., Palmerton, Pa.
B-7 on Light Metals and Alloys, Cast and Wrought	*R. A. Harris, Western Electric Co., Inc., Chicago, Ill.	R. B. Smith, Reynolds Metals Co., Richmond, Va.
B-8 on Electrodeposited Metallic Coatings and Related Finishes	C. H. Sample, The International Nickel Co., Inc., New York, N. Y.	D. M. Bigge, Chrysler Corp., Detroit, Mich.
B-9 on Metal Powders and Metal Powder Products	J. L. Bonanno, The Lionel Corp., Irvington, N. J.	C. G. Johnson, Presmet Corp., Worcester, Mass.
C-1 on Cement	R. R. Litehiser, Ohio State Highway Testing Laboratory, Columbus, Ohio	W. J. McCoy, Lehigh Portland Cement Co., Allentown, Pa.
C-2 on Magnesium Oxychloride and Oxysulfate Cements	E. S. Newman, National Bureau of Standards, Washington, D. C.	K. M. Berg, Midwest Research Inst., Kansas City, Mo.
C-3 on Chemical Resistant Mortars	J. R. Allen, E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.	E. A. Reineck, The Quaker Oats Co., Chicago, Ill.
C-4 on Clay Pipe	*C. R. Velzy, Nussbaumer, Clarke & Velzy, New York, N. Y.	R. G. Scott, Clay Products Assn., Barrington, Ill.
C-7 on Lime	*H. F. Kriege, University of Toledo, Toledo, Ohio	L. E. Johnson, Finishing Lime Association of Ohio, Toledo, Ohio
C-8 on Refractories	J. J. Hazel, Republic Steel Corp., Cleveland, Ohio	*W. O. Brandt, Denver Fire Clay Co., Denver, Colo.
C-9 on Concrete and Concrete Aggregates	*Bryant Mather, Waterways Experiment Station, Jackson, Miss.	*Paul Klieger, Portland Cement Assn., Skokie, Ill.
C-11 on Gypsum	G. W. Josephson, U. S. Bureau of Mines, Pittsburgh, Pa.	R. H. Faber, Gypsum Assn., Chicago, Ill.
C-12 on Mortars for Unit Masonry	*H. C. Plummer, Structural Clay Products Inst., Washington, D. C.	C. U. Pierson, Jr., Marquette Cement Mfg. Co., Chicago, Ill.
C-13 on Concrete Pipe	R. R. Litehiser, Ohio State Highway Testing Laboratory, Columbus, Ohio	H. F. Peckworth, American Concrete Pipe Assn., Chicago, Ill.
C-14 on Glass and Glass Products	L. G. Ghering, Preston Laboratories, Inc., Butler, Pa.	F. V. Tooley, University of Illinois, Urbana, Ill.
C-15 on Manufactured Masonry Units	J. W. Whittemore, Virginia Polytechnic Inst., Blacksburg, Va.	M. H. Allen, Structural Clay Products Research Foundation, Geneva, Ill.
C-16 on Thermal Insulating Materials	*W. C. Lewis, U. S. Forest Products Laboratories, Madison, Wis.	J. M. High, Mundet Cork Corp., New York, N. Y.
C-17 on Asbestos-Cement Products	W. V. Friedlaender, Universal Atlas Cement Div., New York, N. Y.	*Simon Collier, 222 Centre Ave., New Rochelle, N. Y.
C-18 on Natural Building Stones	*W. W. Key, U. S. Bureau of Mines, Washington, D. C.	F. S. Eaton, Research and Design Inst., Wallingford, Conn
C-19 on Structural Sandwich Construction	*Steven Yurenka, Narmco Industries, Inc., San Diego, Calif.	*J. P. Reese, The Martin Co., Baltimore, Md.
C-20 on Acoustical Materials	R. N. Hamme, Geiger & Hamme, Ann Arbor, Mich.	Ralph Huntley, Armour Research Foundation, Geneva, Ill.
C-21 on Ceramic Whitewares and Related Products	*N. T. Morrison, Bell Research, East Liverpool, Ohio	*R. C. Phoenix, Southern Clays, Inc., New York, N. Y.
C-22 on Porcelain Enamel	W. N. Harrison, National Bureau of Standards, Washington, D. C.	G. H. Spencer-Strong, Pemco Corp., Baltimore, Md.
C-23 on Sorptive Mineral Materials	*P. R. Izdepski, Studebaker-Packard Corp., South Bend, Ind.	R. L. Shirley, The Eagle-Picher Co., Cincinnati, Ohio
C-24 on Joint Sealants	*W. F. Koppes, Basking Ridge, N. J.	*J. R. Panek, Thiokol Chemical Corp., Trenton, N. J.
C-25 on Ceramics for Electronics	*R. L. Cook, University of Illinois, Urbana, Ill.	*W. W. Coffeen, Metal & Thermit Corp., Rahway, N. J.
D-1 on Paint, Varnish Lacquer and Related Products	W. T. Pearce, 62 Lodges Lane, Bala-Cynwyd, Pa.	*C. A. Lominska, National Lead Co., Sayville, N. Y.
D-2 on Petroleum Products and Lubricants	Harold M. Smith, U. S. Bureau of Mines, Bartlesville, Okla.	W. T. Gunn, American Petroleum Inst., New York, N. Y.
D-3 on Gaseous Fuels	D. V. Kniebes, Institute of Gas Technology, Chicago, Ill.	K. R. Knapp, 1769 Radnor Rd., Cleveland Heights, Ohio
D-4 on Road and Paving Materials	A. B. Cornthwaite, Virginia Department of Highways, Richmond, Va.	*B. F. Kallas, The Asphalt Inst., College Park, Md.
D-5 on Coal and Coke	*R. I. Coryell, Consolidated Edison Company of New York, Inc., New York, N. Y.	*R. F. Abernethy, U. S. Bureau of Mines, Pittsburgh, Pa.
D-6 on Paper and Paper Products	*H. A. Birdsall, Bell Telephone Laboratories, Inc., Murray Hill, N. J.	R. E. Green, Thwing-Albert Instrument Co., Philadelphia, Pa.
D-7 on Wood	L. J. Markwardt, 12 Lathrop St., Madison, Wis.	*W. A. Oliver, University of Illinois, Urbana, Ill.
D-8 on Bituminous Materials for Roofing, Waterproofing, and Related Building or Industrial Uses	H. R. Snoke, 3805 Williams Lane, Chevy Chase 15, Md.	*H. B. Keene, Minnesota Mining and Manufacturing Co., St. Paul, Minn.
D-9 on Electrical Insulating Materials	*A. H. Scott, National Bureau of Standards, Washington, D. C.	*Thomas Hazen, Union Carbide Plastics Co., Bound Brook, N. J.

Committee	Chairman	Secretary
D-10 on Shipping Containers	*K. W. Kruger, U. S. Forest Products Laboratories, Madison, Wis.	R. F. Uncles, American Cyanamid Co., New York, N. Y.
D-11 on Rubber and Rubber-like Materials	Simon Collier, 222 Centre Ave., New Rochelle, N. Y.	J. J. Allen, Firestone Tire and Rubber Co., Akron, Ohio
D-12 on Soaps and Other Detergents	J. C. Harris, Monsanto Chemical Co., Dayton, Ohio	H. R. Suter, Wyandotte Chemicals Corp., Wyandotte, Mich.
D-13 on Textile Materials	*H. F. Schiefer, National Bureau of Standards, Washington, D. C.	H. A. Ehrman, 9720 Bexhill Dr., Kensington, Md.
D-14 on Adhesives	J. E. Rutzler, Jr., Case Institute of Technology, Cleveland, Ohio	*G. S. Casebolt, American Cyanamid Co., Wallingford, Conn.
D-15 on Engine Antifreezes	R. E. Vogel, Standard Oil Co. (Indiana), Chicago, Ill.	*W. D. McMaster, General Motors Corp., Warren, Mich.
D-16 on Industrial Aromatic Hydrocarbons	W. E. Sisco, American Cyanamid Co., Organic Chemicals Div., Bound Brook, N. J.	K. H. Ferber, National Aniline Div., Allied Chemical Corp., Buffalo, N. Y.
D-17 on Naval Stores	S. R. Snider, U. S. Department of Agriculture, Tobacco Div., AMS, Washington, D. C.	W. A. Kirklin, Hercules Powder Co., Wilmington, Del.
D-18 on Soils for Engineering Purposes	*W. G. Holtz, Bureau of Reclamation, Denver, Colo.	*A. A. Wagner, Bureau of Reclamation, Denver, Colo.
D-19 on Industrial Water	Max Hecht, 5028 Schuyler St., Philadelphia, Pa.	O. M. Elliott, Sun Oil Co., Philadelphia, Pa.
D-20 on Plastics	*J. B. DeCoste, Bell Telephone Laboratories, Inc., Murray Hill, N. J.	*C. F. Ferraro, Food Machinery and Chemical Corp., Princeton, N. J.
D-21 on Wax Polishes and Related Materials	W. W. Walton, National Bureau of Standards, Washington, D. C.	B. S. Johnson, Franklin Research Co., Philadelphia, Pa.
D-22 on Methods of Atmospheric Sampling and Analysis	*J. Cholak, University of Cincinnati, Cincinnati, Ohio	A. T. Rossano, Jr., Division of Engineering, California Institute of Technology, Pasadena, Calif.
D-23 on Cellulose and Cellulose Derivatives	F. A. Simmonds, U. S. Forest Products Laboratories, Madison, Wis.	W. W. Becker, Hercules Powder Co., Wilmington, Del.
D-24 on Carbon Black	N. T. Bekema, United States Rubber Co., Detroit, Mich.	T. D. Bolt, Godfrey L. Cabot, Inc., Boston, Mass.
D-25 on Casein and Similar Protein Materials	*L. E. Clark, Jr., Perkins Glue Co., Lansdale, Pa.	L. E. Georgevits, The Borden Chemical Co., Division of The Borden Co., Bainbridge, N. Y.
D-26 on Halogenated Organic Solvents	*W. D. McMaster, General Motors Corp., Warren, Mich.	Wanda L. Campbell, Vego Chemical Corp., Terre Haute, Ind.
D-27 on Electrical Insulating Liquids and Gases	*E. R. Thomas, Consolidated Edison Company of New York, Inc., New York, N. Y.	*C. A. Johnson, 276 Madison Rd., Scarsdale, N. Y.
E-1 on Methods of Testing	A. C. Webber, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.	P. J. Smith, American Society for Testing Materials, Philadelphia, Pa.
E-2 on Emission Spectroscopy	*R. E. Michaelis, National Bureau of Standards, Washington, D. C.	*D. W. Henthorn, Vanadium Corporation of America, Cambridge, Ohio
E-3 on Chemical Analysis of Metals	Arba Thomas, Armco Steel Corp., Middletown, Ohio	H. Kirtchik, General Electric Co., Evendale, Ohio
E-4 on Metallography	L. L. Wyman, National Bureau of Standards, Washington, D. C.	Mary R. Norton, Watertown Arsenal, Watertown, Mass.
E-5 on Fire Tests of Materials and Construction	*H. D. Foster, RD Box 559, Walden, N. Y.	*I. A. Benjamin, Granco Steel Products Co., St. Louis, Mo.
E-6 on Methods of Testing Building Constructions	R. F. Legget, National Research Council of Canada, Ottawa, Ont., Canada	*J. P. Thompson, American Institute of Timber Construction, Washington, D. C.
E-7 on Nondestructive Testing	J. H. Bly, High Voltage Engineering Corp., Burlington, Mass.	Alexander Gobus, Philips Electronic Instruments, Burlingame, Calif.
E-8 on Nomenclature and Definitions	P. V. Faragher, 314 Sixth St., Oakmont, Pa.	P. J. Smith, American Society for Testing Materials, Philadelphia, Pa.
E-9 on Fatigue	*H. J. Grover, Battelle Memorial Inst., Columbus, Ohio	*R. F. Brodrick, Lessells and Associates, Inc., Boston, Mass.
E-10 on Radioisotopes and Radiation Effects	*E. B. Ashcraft, Westinghouse Electric Corp., Pittsburgh, Pa.	*O. K. Neville, Nuclear-Chicago Corp., Des Plaines, Ill.
E-11 on Quality Control of Materials	S. Collier, 222 Centre Ave., New Rochelle, N. Y.	*D. H. W. Allan, American Iron and Steel Inst., New York, N. Y.
E-12 on Appearance	G. W. Ingle, Monsanto Chemical Co., Plastics Div., Springfield, Mass.	*S. H. Petry, W. M. Welch Manufacturing Co., Chicago, Ill.
E-13 on Absorption Spectroscopy	E. J. Rosenbaum, Drexel Institute of Technology, Philadelphia, Pa.	R. F. Robey, Esso Laboratories, Esso Research and Engineering Co., Linden N. J.
E-14 on Mass Spectrometry	*V. H. Dibeler, National Bureau of Standards, Washington, D. C.	*G. F. Crabie, Gulf Research and Development Co., Pittsburgh, Pa.
E-15 on Analysis and Testing of Industrial Chemicals	*W. A. Kirklin, Hercules Powder Co., Wilmington, Del.	*R. C. Johnson, Manufacturing Chemists' Assn., Inc., Washington, D. C.
E-16 on Sampling and Analysis of Metal Bearing Ores and Related Materials	*J. L. Hague, National Bureau of Standards, Washington, D. C.	*B. D. Krecker, Andrew S. McCreath & Son, Inc., Harrisburg, Pa.
E-17 on Skid Resistance	*E. A. Whitehurst, Tennessee Highway Research Program, Knoxville, Tenn.	*J. H. Dillard, Council of Highway Investigation and Research, Charlottesville, Va.
F-1 on Materials for Electron Tubes and Semiconductor Devices	S. A. Standing, Raytheon Manufacturing Co., Newton, Mass.	*C. L. Guettel, Driver-Harris Co., Harrison, N. J.
F-2 on Flexible Barrier Materials	C. C. Sutton, Quaker Oats Co., Barrington, Ill.	*M. E. Gigliotti, Picatinny Arsenal, Dover, N. J.

British Textile Industry Marks Golden Anniversary

At the Golden Jubilee Conference of the Textile Institute of Great Britain, held last May in London, greetings were presented to the institute on behalf of ASTM by A. G. Scroggie, vice-chairman of Committee D-13 on Textile Materials. Other organizations from many nations were also represented to mark 50 years of growth of the Institute. Total registration for the conference ran well over 300 and included leading textile scientists from many countries. After the opening ceremonies, some 15 papers were presented on various aspects of the technology of textiles.

Papers Invited on Analytical Chemistry and Spectroscopy

The 12th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, sponsored by the Analytical Chemistry Group of the Pittsburgh Section of the American Chemical Society and the Spectroscopy Society of Pittsburgh, will be held at the Penn-Sheraton Hotel in Pittsburgh, Pa., from Feb. 27 to March 3, 1961.

Symposia are planned on new frontiers in optics and spectroscopy, the electron microprobe analyzer, infrared spectroscopy, polarography, and ion exchange. Papers are invited on these subjects and also in all areas of analytical chemistry and spectroscopy. Deadline for receipt of abstracts is Oct. 15, 1960. For more information, write: Dr. W. F. Harris, Westinghouse Electric Corp., Research Laboratories, Pittsburgh 35, Pa.

Technical Committee Notes

In just one short week, during the 63rd Annual Meeting, ASTM technical committees held more than 1000 meetings of main and subcommittees, during which a staggering amount of work was done. Following is a brief account of accomplishments to date and a quick look at plans for the future.

METALS

Steel Committee to Play Active Role in Work of ISO 17

An American Group to handle active participation in the work of Technical Committee 17 on Steel of the International Organization for Standardization has been approved by Committee A-1 on Steel. This eight-man group under the chairmanship of C. L. Kent, Jones & Laughlin Steel Corp., will engage in international standardization work on steel under the auspices of the American Standards Assn., the official American member of ISO. This step marks a change in attitude of the American steel industry, which until now had recommended only observer status in international standardization work.

As a result of discussions with the National Association of Chain Manufacturers, the committee has approved an expansion of scope for Subcommittee XXVII on Steel Chain. Until now, the subcommittee has been interested only in chain produced by welding, and has promulgated Specifications A 391 for Alloy Steel Chain and Specifications A 413 for Carbon Steel Chain. The new scope of activities will include chains manufactured by all processes. New projects under way include welded machine chains and coil chains, chains formed from wire, and chains formed from stampings.

The new Specification A 36 for Structural Steel, which the technical press has been describing quite fully lately, has been approved by Committee A-1 and is expected to be published by the Society early in September. Likewise, the new Specification for High-Strength Low-Alloy Structural Manganese-Vanadium Steel has been approved for publication under ASTM Designation A 441. This material is intended primarily for use in welded bridges and buildings where savings in weight or added durability are important. The atmospheric corrosion resistance of this steel is approximately twice that of structural carbon steel.

The important Specification for Quenched-and-Tempered Steel Bolts and Studs with Suitable Nuts and Plain Hardened Washers (A 325) is expected to be printed in revised form late this year. The new bolt covered by the AISI pamphlet for structural bolted joints will be covered by the revision.

New testing and inspection requirements for cold-drawn steel wire for concrete reinforcement (A 82) and for welded steel wire fabric for concrete reinforcement (A 185) have been approved by the steel reinforcement subcommittee. The revised specifications are expected late this year, after appropriate actions by Committee A-1 and the Society.

The Special Subcommittee on Bearing Steels was organized by Committee A-1 in 1942. From 1948 till 1954 this special subcommittee was relatively inactive. As a result, however, of the recent intense activity in this area, the special subcommittee has been recognized as a permanent group by Committee A-1 and renamed Subcommittee XXVIII on Bearing Steels.

J. J. Kanter, Crane Co., was reelected chairman of Committee A-L. W. S. Scott, Republic Steel Corp., was reelected secretary, replacing H. L. Fryl, Bethlehem Steel Co.

New Corrosion Studies Begin

New atmospheric exposure tests of zinc- and aluminum-coated sheets have been launched by Committee A-5 on Corrosion of Iron and Steel. The zinc-coated specimens include individual hot-dip galvanized and continuous-strip galvanized corrugated roofing sheets.

A new series of aluminum-coated wire and wire products is being assembled to broaden the scope of the wire and wire products test exposures begun in 1936. Exposures are planned for 1961.

Exposure data are being tabulated from recent inspections of the committee's 1928 and the 1958 atmospheric corrosion tests of metallic-coated hardware specimens.

Specifications for galvanized sheets of structural quality were completed and presented to the committee for final letter ballot. In various stages of completion are specifications for:

American Supervisory Group of ISO/TC 17 On Steel at Organization Meeting

(Seated, left to right): J. K. Killmer, Bethlehem Steel Co.; M. S. Northrup, Esso Research and Engineering Co.; J. W. Caum, secretary, ASTM Staff; C. L. Kent, chairman, Jones & Laughlin Steel Corp.; F. H. Dill (for A. S. Marvin), American Bridge Div., United States Steel Corp. (Standing, left to right): P. R. Wray, United States Steel Corp.; W. Rodgers, Republic Steel Corp.; R. E. Hess, ASTM Staff. (Abroad at time of photograph): A. S. Marvin, American Bridge Div., United States Steel Corp.; N. L. Mochel, Westinghouse Electric Corp.; C. W. Wheatley, A. O. Smith Corp.

aluminum-coated sheets, zinc-coated flat steel armoring tape, copper-covered steel wire strand, and aluminum-coated chain link fence fabric.

Specification A 122 covering Class A galvanized wire strand and A 218 covering Classes B and C galvanized wire strand are being redrafted into one specification.

Eight Test Sites To Get New Atmospheric Corrosion Apparatus

Newly developed apparatus[1] to measure the atmospheric factors affecting the corrosion of metals is being constructed for time-of-wetness and sulfur dioxide measurements at four exposure sites in Canada and four in the United States. Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys plans to expose specimens of steel, zinc, aluminum, and possibly copper, for monthly periods in order to study systematically these factors as they affect the corrosion of these metals.

The copper-accelerated acetic acid salt spray test (Cass test) method to evaluate corrosion resistance of metallic coatings in the laboratory was presented to the committee for approval for submission to the Society. A draft of the clay-pack humidity test (Corrodkote test) for metallic coating evaluation was reviewed in draft form.

The atmospheric exposure of zinc and steel specimens to determine the relative corrosivity of 41 test sites in England, Canada, the United States, the Canal Zone, and the Philippines was initiated in May. The test will function over a 3-yr period.

CONSTRUCTION MATERIALS

C-1 Accepts Specification for Cement Processing Additions

The acceptance by Committee C-1 on Cement of a proposed specification for processing additions for use in the manufacture of portland cement marked the completion of a long and intensive study by the Subcommittee on Additions. Up to this time, Committee C-1 has recognized materials used for this purpose by tests of each individual material to determine whether it would be harmful when added in the amounts specified. The new specification will relieve the committee of this responsibility and will place it in the hands of the manufacturer, who will be guided by the specification.

New methods were approved for determining the amount of water-soluble alkali in masonry cements as well as for evaluating false set and potential sulfate resistance of portland cement. The chemical requirements for portland cement in portland blast-furnace slag cement will contain several recommended changes. An increase in the autoclave expansion limits for portland cement is also under consideration. Cooperative tests among 21 laboratories to determine the influence of time of wait during mixing of mortars in the testing of masonry cement have been completed. This program is part of a joint study by Committees C-1 on Cement and C-12 on Masonry Mortars.

The flexural strength test, as used with hydraulic cement mortars, needs a number of revisions, which will be presented to the committee at the next meeting. Changes in apparatus for the autoclave expansion test and for wet sieve fineness determinations are among several that were agreed upon.

The Joint Subcommittee on Cement and Concrete Reference Laboratory was officially established, with equal representation from Committees C-1 on Cement and C-9 on Concrete and Concrete Aggregates. A. A. Bates was named chairman of the new joint subcommittee.

The present Committee officers were re-elected for the coming two-year term.

Officers elected for the coming two-year term are: chairman, C. R. Velzy, Nussbaumer, Clarke, and Velzy; vice-chairman, R. H. Welles, Department of the Navy, Bureau of Yards and Docks; and secretary, R. G. Scott, Clay Products Assn.

Revise Specifications for Clay Pipe Joints

Committee C-4 on Clay Pipe approved a number of revisions in the new tentative specification for vitrified clay pipe joints using materials having resilient properties (C 425). These changes apply principally to test requirements, with the addition of a table for more ready reference to permissible deflections. Two existing specifications, C 261 and C 278, covering both ceramic glazed and unglazed pipe, were discussed on the basis that glazed and unglazed pipe should not be covered in the same specification. It was recommended that these specifications be reviewed with the objective of separating the requirements for the two types of pipe. The committee also decided to expand the existing tables by adding strength and dimensional data for 27- and 33-in. diam pipe.

New Group on Organic Materials Organized in Concrete Committee

The increasing use of epoxy resins and other organic materials in highway construction has led to the organization of a new subcommittee in Committee C-9 on Concrete and Concrete Aggregates. The new group will be known as Subcommittee III-r on Organic Materials for Bonding, Patching, and Sealing Concrete Except Joints, with M. R. Smith, Corps of Engineers, as chairman. This new area of interest will be closely correlated with other ASTM technical committees as well as with outside organizations having an interest in this type of material.

Subcommittee III-d on Specifications for Aggregates and Subcommittee III-e on Methods of Physical Testing of Aggregates were merged in order to avoid duplication of interest. The designation III-e was preserved.

A new Tentative Recommended Practice for Microscopic Determination of Air-Void Content, Specific Surface, and Spacing Factor of the Air-Void System in Hardened Concrete was presented to the Society. Two methods are described: the linear or Rosiwal traverse method and the modified point-count method. A complete revision of the Specification for Fly Ash for Use as an Admixture in Portland-Cement Concrete (C 350) was also submitted, the primary change being the inclusion of requirements of this material as a pozzolan.

Additional specifications and methods of testing admixtures are nearly ready for distribution to Committee C-9 for action. These proposed standards will cover accelerating, retarding, and water-reducing admixtures.

Revisions were proposed in the several methods of testing concrete for strength, the four methods for testing concrete for resistance to freezing and thawing, and the methods of testing aggregates for physical properties, including sieve analysis for amount of material finer than the No. 200 sieve. A final draft of a new test method for modulus of elasticity in compression is ready for circulation in the committee.

Officers elected for the coming two-year term are: chairman, Bryant Mather, Waterways Experiment Station; vice-chairman, Harold Allen, U.S. Bureau of Public Roads; secretary, Paul Klieger, Portland Cement Assn.

New Method for Consistency of Plaster Under Study

A new method for determining the normal consistency of plaster, known as the conical plunger method, is now being investigated by Committee C-11 on Gypsum. This method, a modification of the method described in Methods C 26, is described in some detail in the May, 1960, ASTM Bulletin.

The Methods of Testing Gypsum and Gypsum Products (C 26) are being subdivided into three general sections to provide greater flexibility of use of this comprehensive standard. The

[1] P. S. Sereda, "Measurement of Surface Moisture and Sulfur Dioxide Activity at Corrosion Sites," ASTM Bulletin, No. 246, May, 1960, pp. 47–48.

Technical Committee Notes

three sections, which will be published as separate standards, are: (1) chemical analysis of gypsum and gypsum products, (2) physical testing of gypsum plasters and gypsum concrete, and (3) physical testing of gypsum board products and gypsum partition tile or block.

A proposed specification for joint tape and adhesive for use in treating joints of gypsum wallboard construction has now, after over five years of work, reached the stage of being submitted to subcommittee letter ballot. After subcommittee approval copies will be made available to all who may be interested in reviewing or commenting upon this proposed specification.

Committee C-11 officers were re-elected for another term.

New Subcommittee Setup for Committee C-17

Committee C-17 on Asbestos-Cement Products reached the second milestone in its expansion of interest and scope with a complete reorganization of its subcommittees. The six new subcommittees met for the first time and set up programs for future development of standards in this field. In addition to subcommittees on nomenclature, research, and ISO work, there will now be subcommittees on roofing and siding, flat and corrugated board, and pipe. One of the first projects for the Subcommittee on Pipe will be a complete review of the two Specifications for Asbestos-Cement Pressure Pipe (C 296), and Asbestos-Cement Sewer Pipe (C 428). Work is also continuing in this subcommittee on the alkalinity test.

The present committee officers were re-elected for the coming two-year term.

C-23 Reviews Data from Interlaboratory Studies

Data from interlaboratory studies of bulk density of sorbent minerals as well as methods for mechanical breakdown, oil absorption, water absorption, and water breakdown were reviewed at the meeting of Committee C-23 on Sorptive Mineral Materials. The free fall bulk density method showed excellent reproducibility and will be submitted to committee letter ballot. Other methods being studied include: solubility in water, dustiness, slipperiness, abrasiveness, and ease of removal. The committee is attempting to develop means to measure fire resistance.

A list of terms utilized by the industry has been reviewed and is being submitted to committee ballot.

Joint Sealants Committee Progressing on Three Fronts

Progress is being made on three fronts by Committee C-24 on Joint Sealants. Definitions of terms are being arrived at by compiling terms that are in need of definition and reviewing all existing ASTM definitions. A specification for bulk compounds will eventually be developed, but at present the very definite need for test procedures is recognized. A proposed general specification covering six types of elastomeric compounds was agreed upon to serve as a guide in developing test procedures. Round-robin test programs are now being planned to supply the necessary technical data from which specification limits can be established. The third area being actively pursued is that of preformed shapes. The responsible subcommittee is now engaged in defining performance requirements for buildings and pipe.

The present committee officers were re-elected for the coming two-year term.

New Method Proposed for Cure of Cutback Asphalts

The fact that cutback asphalts have different curing characteristics, even though they meet the same specification requirements, has presented a problem in proper evaluation and identification of this type of material. At the meeting of Committee D-4 on Road and Paving Materials a proposed method of test for determining the rate of curing of cutback asphalts by the rolling ball viscometer method was discussed. This is the first known attempt to measure rate of cure in terms of change of viscosity. This proposed method is subject to letter ballot of the responsible subcommittee.

Committee D-4 will hold a Symposium on Microviscometry Methods and Techniques at the 1961 Annual Meeting. This will be followed at the 1962 Annual Meeting by a Symposium on Kinematic Viscosity.

Attention is being given to new types of emulsions now being commercially produced, with steps being taken to develop specifications. Committee D-4 has established a joint activity with Committee D-8 on Bituminous Materials for Roofing, Waterproofing, and Related Building or Industrial Uses for the establishment of a uniform format for precision statements.

Officers elected for the coming two-year term are: chairman, A. B. Cornthwaite, Virginia Department of Highways; first vice-chairman, R. E. Bollen, Highway Research Board, National Research Council; second vice-chairman J. E. Gray, National Crushed Stone Assn., Inc.; third vice-chairman, J. L. Wilks, Emulsified Asphalt Refining Co.; general secretary, B. F. Kallas, The Asphalt Inst.; and membership secretary, D. W. Lewis, National Slag Assn.

New Specifications for Bituminous Fiber Pipe

Specifications for bituminous fiber pipe will now be available following a letter ballot authorized by Committee D-8 on Bituminous Materials for Roofing, Waterproofing, and Related Building or Industrial Uses. Two specifications were approved—one for homogeneous bituminized fiber drain and sewer pipe and the other for bituminized fiber, laminated-wall drain and sewer pipe. These much-needed specifications are based on methods of test which were developed by the responsible subcommittee and used as the basis for the specification requirements.

A contribution in the field of rheological properties will be available, following committee letter ballot, in the form of a proposed method for defining and measuring the temperature susceptibility of asphalt bitumens. This proposed method will be first published as information in the ASTM BULLETIN.

Officers elected for the coming two-year term are: chairman, H. R. Snoke, National Bureau of Standards; vice-chairman, M. R. Beasley, Central Commercial Co.; and secretary, H. B. Keene, Minnesota Mining and Manufacturing Co.

D-18 Lists 25 Soils Problems

Recent emphasis on basic science of materials, evidenced by the formation of the new Division of Materials Sciences, is being felt in Committee D-18 on Soils for Engineering Purposes. The committee has been research-minded, since its origin; at that time standard methods of test of soils was a virgin field. At the meeting of the Committee held on June 29 during the Annual Meeting, the Research Steering Subcommittee under the direction of Prof. W. S. Housel listed 25 problems on the program of the committee. Such fundamental matters as the physico-chemical properties and the dynamic characteristics of soils are included in this list.

In the field of soil investigations and sampling, the responsible subcommittee is taking advantage of work accomplished by other organizations, such as the Canadian Standards Assn., which has prepared a method of performing cone penetration tests, and the U. S. Bureau of Reclamation, which has perfected a method for vane shear testing of soils. These two methods are being reviewed by the subcommittee for possible incorporation into existing ASTM standards or as publication of new standards.

Methods of test for determination of maximum and minimum density of granular soils are being developed. Capillarity and permeability of soils are being given attention, with a research project established to secure the necessary technical data for a method of test.

The well-known California Bearing Ratio method of test for soils will now be recognized as an ASTM standard, following action taken by the committee in approving a proposed method for letter ballot. In this same field a proposed method of test for density of soil-in-place by the rubber balloon method was also approved, subject to letter ballot.

Renewed activity was noted for bearing tests of soil-in-place. Several items were discussed for future study relating to plate loading tests. In the area of pile load-bearing tests a proposed method for the load capacity of batter pile frames, submitted originally by the U. S. Bureau of Yards and Docks, was approved in subcommittee and will be referred to Committee D-18, following additional minor changes. Additional research problems relating to pile tests include stress conditioning and pile deformation under load, load distribution in side shear and point bearing, stress distribution in the soil mass surrounding a pile, and bearing capacity and action of piles under shock loading.

The committee is planning a symposium on the dynamic properties of soils as well as a general soils session for the 1961 Annual Meeting.

Tribute was paid to retiring Chairman E. J. Kilcawley, who has served in that capacity since 1944. An award was presented to Professor Kilcawley and also to Mr. Harold Clemmer, a charter member of the committee. Recognition was also given to the work of First Vice-Chairman William S. Housel, and Second Vice-Chairman Fred J. Converse, who are retiring from these offices. W. G. Holtz, secretary since 1950, was elected chairman. A. A. Wagner, U. S. Bureau of Reclamation, formerly assistant secretary, became secretary. John P. Gnaedinger, Soil Testing Services, Inc., was elected membership secretary.

Push Subcommittee on Curtain Wall Construction

The establishment of a subcommittee on curtain wall construction was further advanced at an Executive Subcommittee meeting of Committee E-6 on Methods of Testing Building Constructions by the appointment of a chairman, R. A. Biggs, Union Carbide Metals Co.

An important meeting of the entire committee and its subcommittees is now scheduled for November 14 and 15 in Washington, D. C. This meeting will be held in conjunction with the Fall Conference of the Building Research Inst. An interesting program is planned, with an afternoon session of papers on the testing of curtain wall construction in addition to a full schedule of subcommittee meetings.

ELECTRICAL AND ELECTRONIC MATERIALS

Composite Insulation Subject for New Subcommittee

The new Subcommittee on Composite Insulation, organized in 1959, is working on projects to develop tests for slot cell insulation in classes A, B, and AB. L. J. Timm, of the New York Naval Shipyard, is chairman of this new subcommittee of Committee D-9 on Electrical Insulating Materials.

Several revisions are being made in the methods of testing paper for electrical insulation (D 202). These methods are almost constantly under revision because they collect under one designation a large number of test methods for electrical paper. The present activity is on wet-dry density of paper and on quality control and sampling.

Methods of testing various insulating fabrics and tapes are receiving attention; a tearing strength method is to be added to Methods D 295. Also, the test for thermal stability of fabrics by the curved electrode method (dielectric breakdown) will be recommended to the Society for publication as tentative. This method now appears as an appendix to the Compilation of ASTM standards on Electrical Insulating Materials published in 1959.

High Temperature Insulation Problems

Because of their heat resistance, ceramic materials are often used for electrical insulation at high temperatures. A method for measuring the resistance of ceramics at high temperatures has been completed and is being recommended to Committee D-9 for establishment as tentative. Also in the high-temperature insulation field comes a problem from Subcommittee 32 on Thermocouples of Committee E-1 on Methods of Testing. Information is sought on ceramic materials having good electrical insulating properties at temperatures as high as 2500 C. Since there are also problems in high-temperature insulation for magnet wire and for resistance wire, it is planned to pool all these interests to sponsor a symposium on high temperature insulation sometime during 1961.

A. H. Scott of the National Bureau of Standards was elected chairman of Committee D-9, succeeding H. K. Graves of the New York Naval Shipyard. Other officers were re-elected for another two-year term.

Specifications for Cable Oils Ready for Ballot

Specifications for low- and high-viscosity cable oils have been completed by Committee D-27 on Electrical Insulating Liquids and Gases and are ready for approval by letter ballot. Properties required for oils for switch gear and capacitors are being studied; new testing methods may be needed for their determination.

Committee D-27 ranks have been swelled to more than 100 members by the addition of many representatives from the field of insulating gases, a relatively new area for testing methods.

PLANNING COMMITTEE FOR INTERNATIONAL CONFERENCE ON CREEP AND FRACTURE

Pictured at the ASTM Annual Meeting in June are members of the planning committee for the conference to be sponsored by ASTM, ASME, and the British Institute of Metals in the fall of 1963, in New York. (Left to right): R. E. Hess, ASTM Staff; T. W. Eichelberger, Westinghouse Research Laboratories; J. J. Kanter, Crane Co.; H. T. Corten, University of Illinois; M. J. Manjoine, Westinghouse Research Laboratories; P. M. Brister, The Babcock & Wilcox Co.; W. N. Findley, Brown Univ.; A. B. Wilder, National Tube Div., U. S. Steel Corp.; and T. A. Marshall, Jr., ASME Staff. At the time of the photograph, the secretary of the committee, N. L. Mochel, was attending a conference on creep in Dusseldorf, Germany.

Technical Committee Notes

A new test method for inorganic chlorides is now ready for letter ballot approval.

The committee hopes to publish within the next few months an adaptation of the German VDE gap method for dielectric strength.

A method for determining the hydrolyzable chlorine compounds in askarels is being offered for letter ballot approval.

Subcommittee P on Physical Tests failed to agree on a method for determining the coefficient of expansion of petroleum oils and askarels but authorized four new sections to devise methods of test for dew-point measurements, volatility, molecular weight, and carbon types in insulating oils.

F. M. Clark, retiring chairman of Committee D-27, has also retired from active work with the General Electric Co., where he has been engaged for more than 37 years. E. R. Thomas, Consolidated Edison Co. of New York, Inc., will be chairman for a two-year term, and H. W. McCulloch, Jr., Shell Oil Co., becomes vice-chairman. C. A. Johnson, Socony Mobil Oil Co., and R. M. Frey, Line Material Industries, continue as recording secretary and membership secretary, respectively.

ORGANIC AND POLYMERIC MATERIALS

D-5 Sessions Draw Record Attendance

The increasing significance to industry of the work of Committee D-5 on Coal and Coke was evidenced by the record attendance at 13 sessions of the committee during the Annual Meeting. Substantial progress was made toward standard methods for preparing coal samples for analysis and the utilization of mechanical sampling devices. A procedure for the determination of moisture in the method for sample preparation was completed.

An industry request to the committee for standard methods for physical testing of briquets resulted in establishment of a new activity to write such standards.

Standard methods are being developed for studying the plasticity and swelling of coal, including the Gieseler method for measuring plastic properties. A draft of the movable-wall oven for measuring carbonization pressures of coal was presented. Results of a questionnaire covering the design of a sole-heated oven for determining the expansion (or contraction) behavior of coking coals and their mixtures was reviewed, and a method was drafted.

The test for grindability of coal (D 409) is being revised to accommodate fine-size materials such as pipeline coal, fluid coke, and anthracite silt. Data were presented on 85 coals using a modification of the D 409 apparatus in which 16- to 100-mesh coals were tested.

Methods in various stages of completion include the determination of the calorific value of coal and coke by the adiabatic calorimeter, determining the fusibility of coal ash, chemical analysis for chlorine and forms of sulfur in coal, moisture in coal, and a draft method for statistically evaluating sampling techniques.

Committee D-5 is assisting the International Standards Organization to prepare methods of testing coal acceptable for international use. Delegates from the committee met with the Working Group on Testing of Coke in Paris in January, and in Rome in November, 1959. The committee will be represented at the meetings on sampling of coal and testing of coke in Madrid next fall.

Paper Sampling Methods Revised

Protracted study and research by Committee D-6 on Paper and Paper Products have led to revisions of the paper sampling methods. Definitions of terms used for paper sampling are also being developed.

The problems of conditioning paper and the effect that conditioning has on paper testing results have been brought into focus in a Symposium on Relative Humidity and Paper Test Methods developed in cooperation with the Technical Association of the Pulp and Paper Industry, to be presented in Grand Rapids, Mich., on September 28.

Paper test methods now being completed include those for colorimetric determination of starch content, for determining mineral fillers and coatings, for determining sulfur in packaging papers, for determining the flat-crush resistance of corrugated board, and a static bending test for corrugated paper.

The committee formally appointed members to represent ASTM in the U.S. Advisory Committee for ISO/TC 6 and to develop the American opinion for presentation to the ISO.

Effects of Nuclear Radiation on Rubber Materials

Neutron and gamma radiations cause ionization in elastomers, resulting in cross-linking, chain scission, and molecular rearrangement. The general net effect is that either cross-linking or chain scission predominates. Whether the result is good or bad depends on the state of the elastomer, its initial degree of cross-linking or polymerization, its inherent radiation stability, and its chemical and physical environment. These points were made by John W. Born, B. F. Goodrich Co. Research Center, at the Annual Meeting Session on Effects of Nuclear Bombardment on Rubber Materials, sponsored by Committee D-11 on Rubber and Rubber-Like Materials.

The beneficial effects of radiation include polymerization, graft copolymerization, vulcanization, and post-vulcanization. Although all four of these effects can be produced just as well and more cheaply by chemical means, radiation induction has certain advantages. For example, no search is required for the proper chemical agents and conditions, no heating is necessary, and no chemical residues remain to cause undesirable later reactions. Also, more nearly uniform vulcanization of thick rubber objects can be achieved. Mr. Born showed that, assuming a rubber has an optimum degree of cross-linking or vulcanization, any radiation-induced change in the structure is bad. Detrimental radiation effects include overvulcanization (cross-linking), degradation (chain scission), accelerated oxidation and ozonization, unsaturation, and molecular rearrangement. Two methods of inhibiting radiation damage that show promise are physical addition of special inhibitors to rubber compounds and synthesis of elastomers containing inhibiting groups.

L. B. Bangs, Research Division, The Goodyear Tire and Rubber Co., stated that the rate at which ozone is generated by ionizing radiation is sensitive to environmental conditions during the exposure of oxygen to radiation. Temperature, pressure, dose rate, and nitrogen concentration all affect the production rate and equilibrium concentration of ozone.

All Specifications for Wire Insulation Being Reviewed

New specifications for silicone rubber insulation for wire and cable are being completed by Committee D-11 on Rubber and Rubber-Like Materials. The problem of measuring insulation resistance of the newer polyethylene insulating compounds used on wire and cable is under study. All ASTM specifications for insulated wire and cable are being reviewed with a view to standardizing and reducing the number of aging and other requirements.

New definitions of the terms "rubber," "rubber-like," and "rubber products" will be submitted to the Society for publication as Tentative Definitions of Terms Relating to Rubber and Rubber-Like Materials (D 1566). Committee D-20 on Plastics is also studying these definitions.

Specifications for moisture resistance of rubber tape are in preparation. They will also cover butyl rubber, with

requirements for moisture as well as heat resistance.

Consideration is being given to a revision of the Method of Test for International Standard Hardness of Vulcanized Natural and Synthetic Rubbers (D 1415) as regards the use of a pellet-type specimen about half the size of that now specified. This revision, proposed by ISO/TC 45, would produce a useful procedure for determining the hardness of thin pieces.

Revisions were completed of the Methods for Chemical Analysis of Natural Rubber (D 1278) as regards procedures for copper, manganese, iron, ash, and rubber hydrocarbon. A procedure for determining nitrogen in crude natural rubber, being considered for inclusion in Methods D 1278, will include both a semimicro and macro Kjeldahl method.

Plans were made to participate in the ISO/TC 45 program to test the physical properties of seven commercially made grades of natural rubber with cure rates ranging from very slow to very fast. These tests will be made in about 25 laboratories throughout the world. Samples of the rubbers, compounding ingredients, and instructions for the test program are being made available by the National Bureau of Standards. Mooney viscosity determinations on butyl rubber and on compounded natural rubber samples furnished by NBS will be made also. It is hoped that a report on this extensive program can be completed in time for presentation at the ISO/TC 45 meeting in Milan, Italy, in 1961.

A new Table III in the Tentative Recommended Practice for Description of Types of Styrene-Butadiene Rubbers (SBR) (D 1419) will include requirements for the following oils: highly aromatic, minimum 20 per cent saturates; aromatic, 22 to 35 per cent saturates; saturated, 35 per cent minimum saturates; and highly saturated, 65 per cent minimum saturates. This will substitute saturated and highly saturated materials for the naphthenic and paraffinic in the present Table II of Recommended Practice D 1419.

The Subcommittee on Life Tests for Rubber Products has completed its work on correlation of oven and shelf aging. It is planned to submit the extensive data resulting from this 12-yr study for publication in the ASTM BULLETIN.

The SAE-ASTM Technical Committee on Automotive Rubber has completed a new specification for latex dipped goods and coatings and a new specification for automotive air conditioning hose.

Present officers of the committee were re-elected for another two-year term.

New Type Specification to Be Issued for PVC

Vinyl chloride plastics are versatile materials. Some compounds are quite rigid and tough; others are very flexible and rubbery, depending on the formulation and the method of processing. Writing specifications for such broad-spectrum materials presents some problems in providing enough grades and types to embrace all the major categories of properties. A new specification, which is in part a classification for PVC resins, enables the designation of properties for more than 300,000,000 possible combinations. This astronomical number of compounds, many of which, no doubt, would be impossible to produce, can be specified through the use of nine different property levels for six different properties. By extending the nine property levels into subcategories, a total of 26 different property levels can be specified for the six properties for general-purpose PVC resins. For vinyl dispersions for use in organosols and plastisols, a similar classification scheme is provided, with 26 property levels and three properties. For dispersions, over 17,000 possible combinations can be designated. This new specification awaits the approval of the Administrative Committee on Standards.

This is one of the series of photographs from a collection compiled by Prof. Jasper O. Draffin and displayed in the Arthur N. Talbot Laboratory, University of Illinois.

SIR WILLIAM FAIRBAIRN (1789–1874). Born in Scotland, William Fairbairn became apprenticed to a colliery engineer when he was 15 years old. A systematic student, Fairbairn's guiding principle was "indomitable perseverance." He did much engineering and gathered information on wrought iron, strength of boilers, and the collapse of thin tubes. Of greatest importance was his promotion of the use of wrought iron in place of cast iron.

"A very slight acquaintance with natural science will exhibit the wisdom of a bountiful Creator in the wide diffusion and abundant supply of iron and coal, two of the greatest boons conferred upon the human race. If we refer to the history of the past and trace the change from barbarism to a state of intellectual culture we see at every step the contrivances and appliances of the 'cunning workers in iron.' These have always been the associates of mental progress and the forerunners of supply to the wants and necessities of our social existence."

Iron—Its History, Properties, and Processes of Manufacture

Technical Committee Notes

Definitions for Elastomer, Rubber Debated

Since rubber may be considered an elastomer, and since many elastomers may also be considered to be plastics, there have been some differences of opinion surrounding the definitions of these terms in Committees D-11 on Rubber and D-20 on Plastics. To come to some understanding, the two committees have established a Joint Committee on Definitions. At the Annual Meeting, this group arrived at definitions for "rubber" and for "rubber-like," which will be balloted in the respective committees to obtain agreement, if possible. Committee D-20 has submitted sixteen definitions of terms relating to cellular plastics to the Society for publication in a revision of Definitions of Terms Relating to Plastics, D 883.

It has long been known that rate of loading is an important variable in measuring properties of plastics. The plastics committee has initiated work on high-speed tension testing to supplement similar efforts over many years with high rates of loading for impact and flexure testing.

The Plastics Committee will extend its efforts into the development of suitable test methods for evaluating pertinent performance properties of end items such as certain plastics products used in building. This expansion will cover individual items and categories of items on a basis of demand and indicated need for standards. The decision of the committee to extend its efforts beyond plastics materials and compounds is a result of the recognition of problems faced nationally by the plastics industry in gaining confidence in the use of plastics in building.

New Casein Standards Coming

Committee D-25 on Casein and Similar Protein Materials met in Chicago on May 26 to review progress on the development of physical methods. Data from interlaboratory studies for standard methods of measuring adhesive strength, fat content, bacteria count, and mold estimation were reviewed.

Cooperative tests with 15 laboratories in conjunction with the TAPPI Coating Committee are being made to determine the viscosity and adhesive strength of caseins used in the paper industry. Samples of clay, casein, isolated soy protein, and paper were sent to all participating laboratories. This work represents the first attempt by any organization to set up a procedure for preparing a standard paper coating using a given raw stock.

Considerable work is in process to study the various methods of measuring the viscosity of casein and soy protein solutions using five types of standard viscometers. In addition to the seven chemical methods that were accepted by the Society at the Annual Meeting, standard methods for dirt content, foaming characteristics, insoluble matter, minimum alkali content, and odor are being developed.

CHEMICAL PRODUCTS AND PETROLEUM

C-7 to Survey Agricultural, Chemical Fields

Committee C-7 on Lime will take a new look at the agricultural field to evaluate the need for national standards to cover agricultural liming materials, both lime and limestone. A new subcommittee has been established to study this field. A. H. Nieman, Ohio Lime Co., will serve as chairman.

Of equal interest to the committee is the possible development of standards for limestone for the chemical and process industries. The scope of the present subcommittee on chemical lime will be expanded to include limestone. It is considered that the present standards for chemical lime can be expanded to include limestone for similar purposes.

Officers elected for the coming two-year term are: chairman, H. F. Kriege, Toledo Research Foundation, Toledo Univ.; vice-chairman, R. K. Thomas, Warner Co.; vice-chairman, E. T. Carlson, National Bureau of Standards; and secretary, L. E. Johnson, The Finishing Lime Association of Ohio.

Traffic Paint Specifications Under Study

A paper, "The Relation Between Systems and Color Usage," by Walter C. Granville, Industrial Color Consultant, was the main feature of the meeting of Committee D-1 on Paint. In the meetings of more than 80 subcommittees and working groups action on many studies and projects was reported.

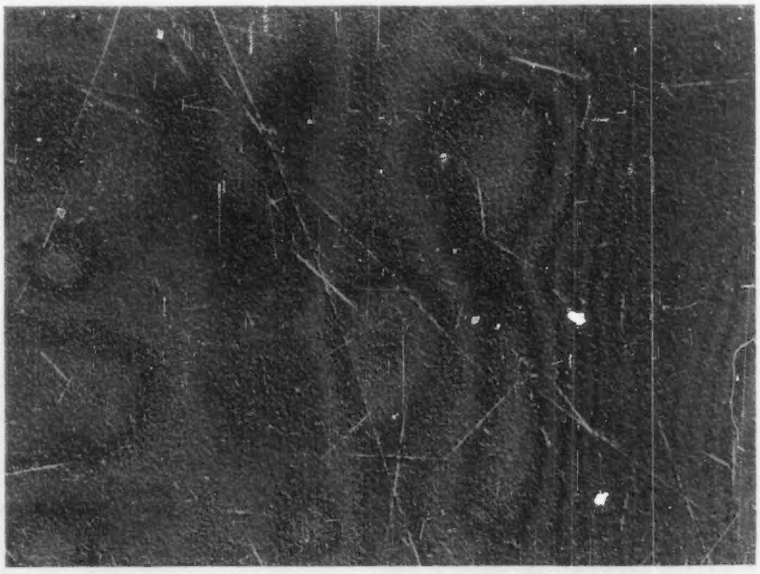
Traffic paint purchase specifications of states and other agencies are under study through a working group on accelerated testing. State highway departments may be polled on the value of present tests.

Plans to review the six individual methods for color difference measurements looking toward consolidation were reported by the Subcommittee on Optical Properties. Also an attempt will be made to develop techniques for checking the accuracy of colorimeters.

A working group is initiating an interlaboratory test program to evaluate a proposed method for determining the rheological properties of thixotropic or gel-type paints.

Plans also were made for additional interlaboratory test programs for measuring initial and ultimate set for glazing and caulking compounds. Further studies will cover accelerated weathering.

W. T. Pearce of Bala-Cynwyd, Pa., was re-elected chairman of the committee for a two-year term. John C. Weaver, The Sherwin-Williams Co., was elected vice-chairman, and C. A. Lominska, National Lead Co., was elected secretary.



FISSION FRAGMENT TRACKS IN THIN URANIUM DIOXIDE FILM

Preshadowed carbon replica of free surface of irradiated uranium dioxide film. Platinum shadow at $\tan^{-1}\frac{1}{3}$ Final magnification 50,000X, reduced for publication. Twelfth ASTM Photographic Exhibit. T. S. Noggle and J. O. Stiegler, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Nuclear Industry, Home Owners May Benefit from D-2 Activity

A coordinating division on nuclear problems has been organized in Committee D-2 on Petroleum Products and Lubricants. Under its chairman, Leo P. Manley, Socony Mobil Oil Co., Inc., the new division has mapped a program of activity and assigned areas of liaison and technical surveillance. An open forum is planned for the 1961 ASTM Annual Meeting.

Possible revision of the burner fuel oil specifications (D 396) may provide sharper delineation between No. 1 and No. 2 oils to narrow the range for acceptable fuels for No. 2 grade. Many feel that these changes would result in fewer adjustments to oil burners and would enable burners to operate at top efficiency more easily.

Committee D-2 has two symposia in the works. On Oct. 11, 1960, it will sponsor a Symposium on Non-Newtonian Viscometry, in the Mayflower Hotel, Washington, D. C. In February, 1961, it will sponsor a Symposium on Research on Gasoline, at the Benjamin Franklin Hotel, Philadelphia Pa. The latter symposium may affect future specifications on gasoline and will discuss antiknock measurement, road octane number, rumble-thud, and other abnormal combustion effects.

Harold M. Smith, U. S. Bureau of Mines, was re-elected chairman of the committee for a two-year term. T. B. Rendel, Shell Oil Co., Inc., will succeed R. C. Alden as first vice-chairman. W. K. Simpson, General Motors Corp., and W. T. Gunn, American Petroleum Inst., were re-elected second vice-chairman and secretary, respectively. R. R. Wright, American Petroleum Inst., was elected assistant secretary.

New Methods for Analysis of Synthetic Detergents

Although there have been available for some time a wide range of methods for the analysis of soaps and of alkaline detergents, ASTM methods for the analysis of synthetic detergents have been fewer in number. Two new methods in this area that were approved by Committee D-12 on Soaps and Other Detergents cover the determination of ethylene diamine tetraacetate and a method of test for sodium alkylbenzene sulfonate by ultraviolet absorption.

Work of Committee D-16 Is Benefiting Consumer

The work of Committee D-16 on Industrial Aromatic Hydrocarbons and Related Materials has created a broader understanding of the problems in commercial production, testing, and distribution of high-quality and industrial grades of benzene, toluene, and xylenes. Differences in consumer preferences on quality requirements have been lessened, so that it is now possible to reduce the number of grades that need to be specified. This provides real savings to the ultimate consumer.

Specifications for refined phenol and methods for phenol assay are being developed, as are methods for styrene monomer and polymer. Test methods are being written for determination of oil and naphthalene, distillation range, specific gravity, water content, and solidification point of tar acids.

A protracted study of means of determining relative amounts of xylene isomers has resulted in publication of a proposed standard method using the infrared technique. Work is continuing on development of a standard gas-liquid chromatographic procedure to replace the infrared method. Additional tables for calculation of volume and weight of mixed xylenes are slated for publication as part of the Tentative Tables, D 1555.

The expanding production and consumption of polycyclic aromatics, phenolic compounds, and nitrogen derivatives as source materials for a number of products has led the committee into new areas of activity. The combined resources of industrial producers and consumers are being directed at solving the problems of purity as related to the end use of the material. Advanced skills and techniques are being employed to develop new information on impurities that impair the use of the products.

The production of standard solidification point cells for naphthelene and phthalic anhydride are being cooperatively developed with the National Bureau of Standards. Methods for determination of impurities in naphthelene, pyridine, and phthalic anhydride are in various stages of completion.

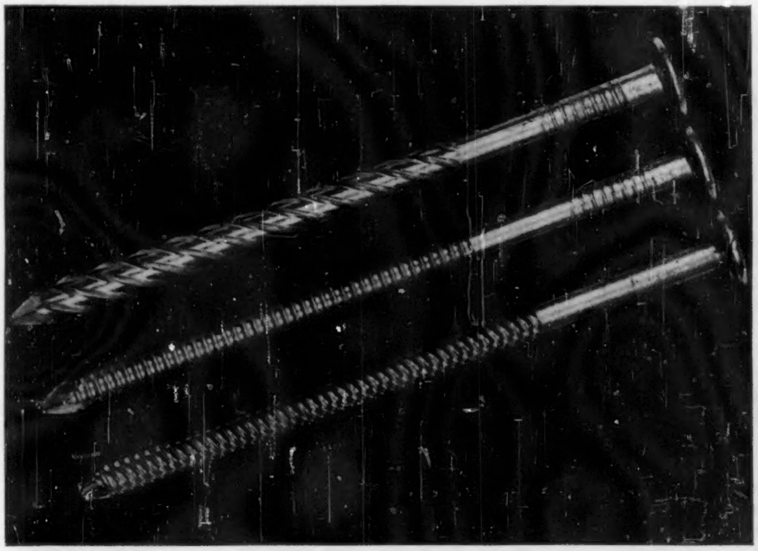
Committee D-16 is participating in the work of ISO/TC 78 on matters relating to standards for industrial aromatic hydrocarbons.

COORDINATION, ANALYSIS, AND TESTING

Propose New Committee on Gas Chromatography

The need for standardization in the field of gas chromatography is becoming acute. For some time, Committee D-2 on Petroleum Products has been developing gas chromatography standards as applied to hydrocarbons. Committee E-15 on Analysis and Testing of Industrial Chemicals had considered establishing a subcommittee on this subject, but at a meeting of members of Committees E-15 and D-2 and others interested in gas chromatography, it was decided that the problems are so broad and the interest so great that the establishment of a separate ASTM committee on this subject seemed justified. A recommendation to this effect is being presented to the Board of Directors.

Committee E-15, on the basis of returns from a questionnaire, voted to participate actively in international standardization work of ISO/TC 47 on Chemistry. The group will not participate in any specifications work, as this is excluded from the E-15 scope. Steps will be taken to organize a USA national committee for ISO/TC 47 following the approval of the recommendation by ASTM and ASA.



IMPROVED NAILS

Twelfth ASTM Photographic Exhibit. Second prize, general class, black-and-white—materials. E. G. Stern, Virginia Polytechnic Inst., Blacksburg, Va.

Technical Committee Notes

Methods Development

The general methods subcommittees of Committee E-15 are working actively on methods for chlorine and sulfur in organic compounds, and for hydroxyl content and unsaturation. In the group studying water methods, there were representatives from a number of other interested ASTM committees. The subgroup on water has established task groups which will be concerned with several aspects of the Karl Fischer method—reagents, apparatus, interfering groups, and coordination.

Work on density-temperature tables for liquid industrial chemicals is going forward, and plans are to use a format similar to that for density-temperature tables for aromatics (D 1555).

Progress is being made on recommended procedures for interlaboratory tests and for expressing precision and accuracy. The first phase of this task, published in the Annual Report of Committee E-15, preprint, included the glossary portion of Recommended Practice for Developing Precision Data. The committee agreed to accept the concept of accuracy proposed by Committee E-11 on Quality Control—that accuracy includes both the concepts of precision and bias. It has been the practice in analytical chemistry to consider accuracy practically synonymous with lack of bias.

The officers of the committee and members-at-large of the Executive Committee were re-elected for another two-year term.

Measuring Space Vehicle Temperatures

Thermocouples for temperature measurement on airframes and space vehicles will be studied by a new subcommittee of Committee E-1 on Methods of Testing. The subcommittee plans to sponsor a symposium on the application of thermocouples in the airframe and space industry with particular emphasis on transient thermal conditions. The symposium is tentatively scheduled for the Society's Annual Meeting in June, 1961.

Committee E-1 also organized new task groups to study thermal conductivity tests of metals and to develop linear expansion tests for both metals and nonmetals. The Subcommittee on Microscopy held an informal technical session on the subject of noncommercial accessories for both optical and electron microscopes. Consideration was given to sponsoring a symposium on the preparation of materials for microscopic examination at a national meeting of the Society. No date was established.

Definitions of terms relating to specific gravity, which have been unchanged since 1927, were scrutinized by the Subcommittee on Density, which proposed a revision that will expand the Standard Definitions of Terms Relating to Specific Gravity (E 12) to include density and specific gravity of solids, liquids, and gases. The present terminology in various ASTM standards in some instances is inconsistent and the committee intends to clear up the confusion.

A modification of Tentative Methods of Verification of Testing Machines (E 4) was proposed to increase the recommended interval between verifications from 6 months to 12 months for testing machines that are in constant use. Procedures for calibration of testing machines under 2000-lb capacity are being developed.

Officers of the committee were re-elected for another 2-year term.

E-2 Plans Third Edition for Emission Spectroscopy Methods. E-3 to Reissue Methods for Chemical Analysis of Metals.

A planned third edition of *Methods for Emission Spectrochemical Analysis* will include 37 suggested methods and practices, to be published as information only, and six revisions of methods from the previous edition, according to Committee E-2 on Emission Spectroscopy. Of special interest among the new suggested methods and practices are a method for analysis of indium, practices for the use of statistical methods in spectrochemical analysis and for establishing spectrochemical analytical curves, and eleven new methods for analysis of steel and iron. Also to be included are new tentative recommended practices for spectrochemical computations and for describing and specifying the spectrograph.

A new edition of the Book of ASTM Methods for Chemical Analysis of Metals will be published late in 1960. Primarily the responsibility of Committee E-3 on Chemical Analysis of Metals, the new edition will contain several completely new groups of methods, including methods for analysis of ferroboron, zirconium, and metal powders, as well as a number of other new and revised methods. The general recommended practices for apparatus and reagents and for photometric practice are among the extensively revised material.

Arrangements were made for a symposium on extension of sensitivity of methods, for presentation at the 1961 Annual Meeting, under joint sponsorship of Committees E-2 and E-3.

Newly elected officers of Committee E-2 are: chairman, R. E. Michaelis, National Bureau of Standards; and secretary, D. W. Henthorn, Vanadium Corporation of America. Committee E-3 officers were re-elected for another term.

E-14 Urges Distribution of Mass Spectral Data on IBM Card Index

Some 85 papers covering all phases of mass spectrometry were presented at sessions of Committee E-14 on Mass Spectrometry. Special emphasis was given to photoionization, solids analysis, and measurement of uranium isotope abundance.

Committee E-14 recommended that the Society undertake to distribute a punched IBM card index to mass spectral data, similar to the presently available ASTM-Wyandotte index to absorption spectral data. A master deck for this purpose is under preparation in the committee.

New elected officers of the committee are V. H. Dibeler, National Bureau of Standards, chairman; and G. F. Crable, Gulf Research and Development Co., secretary.

Typewriter Ribbons and Carbon Paper Subject of ASTM Study

Businessmen and their secretaries will benefit from the work of a new Subcommittee on Standards for Typewriter Ribbons and Carbon Paper organized by Committee E-12 on Appearance. The new group, under the chairmanship of W. E. Grady, Carter's Ink Co., has the following scope: (1) to compare methods now being used to evaluate the appearance qualities of the printed copy made by typewriter ribbon and carbon paper, (2) to determine whether improvements and new features are required, and (3) to prepare standard test methods for evaluating the color, density, sharpness, and other properties affecting the appearance of the printed copy.

The organization meeting was devoted to naming and defining the appearance properties of carbon paper and typewriter ribbons with which the industry and the trade are concerned. For identification these were divided into two classes: (1) properties of the impression, and (2) properties of the carbon paper or typewriter ribbon itself. Arrangements were made to conduct a series of interlaboratory tests to determine more specifically how different laboratories in the industry measure intensity and to what extent the present test methods agree.

Committee E-12 submitted to the Society the first standard test methods ever prepared for the goniophotometry of reflecting and transmitting materials. These procedures are needed to identify the appearance properties of

aluminum, stainless steel, chromium and nickel plating, and other metallic finishes, also for translucent plastics used in lighting fixtures, for paints, and for many other materials.

George W. Ingle, Monsanto Chemical Co., Plastic Div., was re-elected chairman of the Committee for a 2-year term, and Stanton H. Petry, W. M. Welch Mfg. Co., was elected secretary.

Techniques for IR, UV Analysis Advanced to Tentative

Experience with the proposed recommended practices for general techniques of infrared and ultraviolet quantitative analysis, that had been published heretofore as information, were found to justify the advancement of these practices to tentative on the recommendation of Committee E-13 on Absorption Spectroscopy. Availability of these practices in tentative status should simplify the writing of specific methods for analysis by absorption spectroscopy.

New Skid Resistance Committee Studies Subcommittee Structure

The study of the fundamentals and evaluation of skid resistance was inaugurated in ASTM through the recent organization of Committee E-17 on Skid Resistance. The great interest in and need for standards in this field was evidenced by the good attendance at the first meeting of E-17, held during the Annual Meeting. Represented were many highway departments, the Bureau of Public Roads, tire and rubber companies, the road materials industry, universities, the Federal Aviation Agency, and other related interests.

A review of the proposed title and scope emphasized that even though primary attention would be given to highway and runway surfaces, the committee would consider all types of traffic surfaces. The following scope was approved:

(*a*) To develop and standardize field and laboratory methods of test for determining traffic surface slipperiness.

(*b*) To develop and standardize methods of test for the use of a set of standards of traffic surface slipperiness.

(*c*) To stimulate research to accomplish the foregoing purposes.

Certain areas of interest were agreed upon for possible subcommittees. These are: stopping distance test method, trailer method, other field methods, laboratory methods, laboratory-field coordination, standards of surface slipperiness, tire characteristics and significance, and side friction measurements. The committee will be canvassed on this subject.

The first officers of the committee are: chairman, E. A. Whitehurst, director, Tennessee Highway Research Program; first vice-chairman, Harold Allen, U. S. Bureau of Public Roads; second vice-chairman, Henry J. Lichtefeld, Federal Aviation Agency; and secretary, J. H. Dillard, Virginia Council of Highway Investigation and Research.

First Test Method Published for Cation-Exchange Materials

The acceptance of a new method of test for operating performance of sodium-cycle cation-exchange materials for removal of calcium and magnesium ions from industrial water represents the first published standard resulting from this relatively new area of activity in Committee D-19 on Industrial Water.

Methods of test for phenolic compounds provide additional means for evaluating both industrial water for use in a plant and industrial waste water from the plant.

New projects in the committee include the preparation of purchase specifications (and related test methods) for heavy water; work on the determination of additional elements (chlorides, nickel, aluminum, and zinc) in high-purity water; and the organization of a new subcommittee on methods of radiochemical analysis.

The committee-sponsored research project for vaporous carryover in boilers is nearing completion. Results will soon be available for study, and it is expected that a report on the project will be presented at a symposium on steam impurities that the committee is planning to sponsor at the 1961 Annual Meeting.

Joint Committee Reviews Methods of Water Examination

The Joint Committee on Uniformity of Water Examination has completed its fourth year of operation. The objectives of JCUMWE are: (1) to review the methods of water examination, published by member organizations, for the purpose of obtaining uniformity in sampling, testing, reporting test data, terminology, and in application; and (2) to provide a mechanism for the exchange of information of these matters by member organizations. These objectives are accomplished by review panels made up of experts in their fields of specialty.

Official JCUMWE recommendations have been approved for: reporting of results, total hardness, iron, organic nitrogen, grease and oily matter, and solids. The last four were approved during the past year. They have been transmitted to member organizations.

An important precedent was established in the JCUMWE recommendations for grease and oily matter. After thorough study, it was decided that it is impossible to reach uniformity for the several methods that were reviewed. The objectives of the several methods are different, and the different solvents used in the methods give results for which there is no basis for comparison. It is not unlikely that other methods that come under review by JCUMWE may result in a similar conclusion.

Reports of three panels were accepted as preliminary recommendations: sulfates; uniformity of reagents; and acidity, basicity, and alkalinity. These recommendations will be sent to member organizations for review and comment.

New panels will be set up for: turbidity; calcium and magnesium; carbonate, bicarbonate and carbon dioxide; electrical conductivity; fluoride; ammonia; total phosphorus; and nitrite.

The ASME changed from inactive to active status during the past year. This makes 11 of the 12 member organizations that are maintaining active participation in all phases of the program.

Officers of New Committee E-17 on Skid Resistance

(Left to right): Harold Allen, vice-chairman, U. S. Bureau of Public Roads; E. A. Whitehurst, chairman, Tennessee Highway Research Program, University of Tennessee; and Henry J. Lichtefeld, second vice-chairman, Federal Aviation Agency.

Random Samples...

FROM THE CURRENT MATERIALS NEWS

Mystery of Magnetic Annealing Partially Solved

One of the unsolved mysteries of metallurgy, magnetic annealing, is coming closer to solution through research being conducted at Bell Telephone Laboratories. For many years, it has been known that if soft magnetic alloys of nickel-iron or nickel-cobalt-iron are heat treated in a strong magnetic field, their magnetic moments will tend to align to produce a magnetically oriented material. This tendency arises from a uniaxial magnetic anisotropy introduced by the field heat treatment. The origin of this uniaxial anisotropy, however, has not been satisfactorily understood.

Large quantities of such alloys are used in inductor cores for communication equipment. Fine tapes are used in various electronic memory devices. Also, it is possible that thin films of these alloys could be used in memory devices for digital computer circuits since they can be switched from one polarization direction to the opposite with an overriding magnetic field. Switching times for such films could be as short as 10^{-9} sec. They could also be used in nondestructive readout memory devices, by sensing the polarization with a magnetic field which does not quite override the built-in field.

The generally accepted theory for magnetic field annealing is based on short-range ordering of the metal atoms in the alloy. Recent work at Bell Laboratories indicates, however, that magnetic polarization does not result when these alloys are heat treated in a field unless about 14 ppm of oxygen are present in the alloy. With less than this oxygen content, the annealed alloys do not respond, and no uniaxial anisotropy is developed.

At oxygen contents between 14 and 20 ppm, there is apparently little variation in the strength of the anisotropy. Although there appears to be little appreciable change in the magnetic response for reasonable increases above this level, substantially greater amounts of oxygen may result in the formation of oxides of the constituent metals.

While the mechanism by which oxygen causes this effect is not yet fully understood, workers at Bell Laboratories theorize that the oxygen atoms deposit on the stacking plane of the crystal at certain elevated temperatures resulting in a displacement or dislocation of the next plane of atoms. When enough of these oxygen atoms are present, the alloy can be magnetically oriented by field heat treatment.

Confirming the theory is complicated by the fact that it is almost impossible to point out the location of the oxygen atoms in the alloys by X-ray or neutron diffraction techniques, or even whether the alloy itself has segregated, because of the similarity between the atoms of cobalt, nickel, and iron. Also, of course, the minute quantities of oxygen involved make the analytical problems significant.

From a practical standpoint, it seems that more uniform magnetic materials can be produced by close control of the amount of oxygen present in the alloy. However, a great deal more study will be required before the theoretical basis for the phenomenon of magnetic annealing is understood in complete detail.

Urethane Foam Joins the Fleet

When the atomic submarine *Skipjack* slid down the ways, white pine and resinous pitch joined the ranks of retired mariners.

These old seagoing hands, long used to fill structural voids in submarine hulls, have been replaced by a youngster of the chemical industry—urethane foam. Foamed in place in these voids, the urethane cuts more than 8.5 tons from the submarine's weight. And some 16,000 lb of foam insulate the reactor core of its atomic power plant.

Ashore, urethane compounds are helping make possible a wide array of products. The variety of these products ranges from crack-resistant, patent leather shoe finishes to coatings for rubber toys, from interlining for cold weather clothing to bedding and cushioning, and from refrigerator insulation to radome noses for military aircraft

The actor-like ability of urethanes to play such varied roles results from the blending of such tongue-twisting chemicals as tolylenediisocyanates with polyester or polyether resins Simply by varying the formula, the chemist can produce a urethane foam rigid enough to jump on, soft enough to lie on, or flexible enough to stretch 600 per cent of its length. He can make a substance as strong as metal yet as resilient as rubber. Urethane can be made porous enough to absorb 20 times its weight in liquid, or tough enough to withstand safety temperatures from 212 to −30 F.

More than $500,000 a month is being spent on basic research in the urethane industry. It adds up to one thing: Commerical realization of many of the exciting new uses may be much closer than tomorrow.

Chemical News
Jan.-Feb., 1960

"Soft" Tungsten Mystifies

Researchers at the U. S. Bureau of Mines, Albany, Ore., have stumbled onto an unusual form of tungsten. So far as they can tell from their tests, the metal is almost pure tungsten. Yet, by comparison with ordinary tungsten, it is softer, less brittle, and more deformable. Biggest difference is in crystal size, which is many times smaller than crystals of tungsten produced by arc melting, for example.

The Bureau doesn't yet have enough data to tell whether the ductility of its tungsten is related to adsorbed gases. In fact, the finding is so new that there are as yet no hardness figures.

The metal has been hammer forged at 900 C—a temperature considered quite cool for tungsten—to 70 per cent of its original thickness. At the same time, porosity was eliminated without crumbling. A more impressive measure of the metal's softness: It can be hacksawed. Try this with ordinary tungsten and you'll simply run out of blades.

The problem now is to find out more about the metal so it can be put to some practical use. If it can be successfully formed into sheets, the most obvious application is as a fabricating material in high-speed aircraft. No metal has a higher melting point than tungsten.

Chemical and Engineering News
Jan. 4, 1960

(*Continued on page 92*)

Devices for Simulating Gun Firing Under Static Conditions

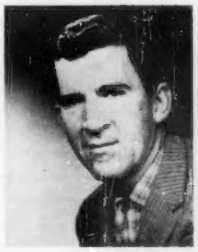
By J. P. NOONAN, R. W. HEINEMANN, S. J. LOWELL, and P. B. TWEED

Three devices which simulate the conditions of artillery shell firing are described. In all three devices, the pressures created by hot propellant gases are used in a controlled environment to simulate the conditions of gun firing and other phenomena in which materials are subjected to high pressures at high rates of loading.

THE PRIMARY function of the three devices described in this paper is to simulate the conditions of artillery shell firing and thereby to eliminate the need for safety firing programs. Such programs are extremely costly and time consuming, and the statistical significance of their results can be only as sound as the number of firings on which such results are based. It is obvious that the safety of a round of ammunition cannot be predicted with absolute certainty from a limited number of firings. To increase the significance of a relatively small number of firings, it has become the practice to fire shells under extreme conditions of temperature and pressure. Yet the extent to which these extreme conditions increase the statistical significance of the firing results has never been established, chiefly because of the prohibitive costs of the tests.

In the past, various attempts have been made to apply the data from relatively simple tests, such as the drop or friction tests of explosives, to determine whether a high explosive shell can be safely fired from a gun. These attempts have failed because no quantitative correlations were evident. It became apparent that a more scientific investigation would have to be made of the factors responsible for the sensitivity of explosives during shell firings and the effects of these firings on shell bodies and fuzes.

Three devices were developed in which the effects of shell firing on explosives, fuzes (and other small components), and shell bodies could be simulated (**1, 2**).[1] These three devices are: (1) the activator, a laboratory test device which applies impulse pressures and thereby simulates the setback[2] to which explosives are subjected in shells when fired from a gun; (2) a static test



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STANLEY J. LOWELL received his B.S. degree from Columbia University and pursued graduate studies at Berlin University, Germany. In 1941 he became engaged in research and development in the field of adhesives and plastics for Army Ordnance at Picatinny Arsenal, Dover, N. J. For the past 10 years his work at Picatinny Arsenal has been connected with improving explosives and determining their suitability for specific military applications. At present he is Chief of the Explosion Dynamics Unit.

PAUL B. TWEED has B.S. and M.S. degrees in chemistry from Rensselaer Polytechnic Institute, and an M.A. in Educational Administration from New York State College for Teachers. After 4 years work in rubber technology with the American Hard Rubber Co., he came to Picatinny Arsenal. He has had 20 years experience in the development of ammunition, explosives, and initiators. At present he is Deputy Chief for Explosives Applications, Artillery Ammunition and Rocket Development Laboratory.

NOTE—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author or authors. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

[2] The rearward force of inertia created by the forward acceleration of a projectile. The force is directly proportional to the acceleration and mass of the parts being accelerated.

device in which the effects of gun-firing pressure on the bases of shells are simulated; (3) the Hi-G device, which propels small components at accelerations as high as 200,000 g and velocities greater than 2000 ft per sec against armor plate, thereby making it possible to evaluate the effects of high acceleration and abrupt deceleration on such components.

These devices represent different applications of a single operating principle. In all three, the pressures created by hot propellant gases are used in a controlled environment to simulate the conditions of gun firing and other phenomena in which materials are subjected to high pressures at high rates of loading. The devices provide a convenient and relatively inexpensive means of controlling the variables associated with such phenomena.

The Activator

The activator is basically a simple piece of equipment (Fig. 1). It consists essentially of a firing chamber, an explosive test specimen chamber, a backstop, and a means of igniting the propellant (or other suitable chemical fuel) and transmitting a compressive force to the test specimen. Determining the impact sensitivity of an explosive with the activator is a more sophisticated technique than the drop test, the only comparable method used heretofore.

The activator is operated as follows:

1. A propellant charge is weighed into a small bag into which an electric squib[3] is inserted.
2. The explosive specimen to be tested is placed in a cartridge, which is then assembled between two punches. This assembly is aligned between the piston in the propellant chamber and the backstop.
3. The propellant bag with attached squib is placed in the firing chamber. The squib leads are attached to the proper junctions on the electrical firing head.
4. The specimen cartridge assembly is then enclosed by a barricade.
5. A pressure gage (developed at Picatinny Arsenal and operating on the Wheatstone bridge principle) is inserted into the firing chamber to measure the pressure, and the lead wires are connected to the recording equipment (Fig. 2). The chamber may be designed to take a needle valve or to have a constant opening, either of which serves to relieve the pressure after the peak has been reached.
6. The instrumentation is calibrated and the propellant charge electrically ignited. When the firing switch is closed, a drum camera begins to rotate. As soon as the proper camera speed is reached, an electric current is passed through the firing head to activate the squib, which in turn ignites the propellant.

The rapid burning of the propellant charge exerts a pressure on the piston which is transmitted to the punch and, in turn, to the explosive specimen. Shear pins are used to prevent the piston from moving until the chamber pressure builds up sufficiently to rupture the pins. This brief delay reproduces more exactly the conditions of actual shell firing in that it simulates "bullet pull," the force required to pull a projectile from its cartridge case. The specimen is compressed against the opposite punch, which is held firmly by the screwjack threaded into the backstop. The rapid compression of the specimen simulates the setback when a shell is fired in a gun, and either does or does not explode the specimen.

The gas pressure in the firing chamber unbalances the Wheatstone bridge in the pressure gage, thereby producing a voltage surge which passes through the various instruments. A trace of the pressure-time relationship is produced. The effect of the test on the specimen is determined from this trace and by visual examination.

In addition to its primary function of measuring the sensitivity of explosives to initiation by simulated setback or by impulse pressures, the activator has been used to investigate other factors affecting the initiation of explosives, such as: adiabatic compression of air cavities, the sensitizing action of grit and rough surfaces, the value of desensitizers, and variations in density.

The activator is not limited to use with explosives only. It can also be used to study the effect of impact forces on structural materials, both metallic and nonmetallic. By replacing the explosive specimen cartridge assembly with a test specimen of convenient shape, and providing suitable strain gages and instrumentation for the specimen, this device can be used to study the behavior of materials in rapid compression. By a minor modification in design, the operation of the activator can be reversed so that it also serves as a tension tester for sudden load applications.

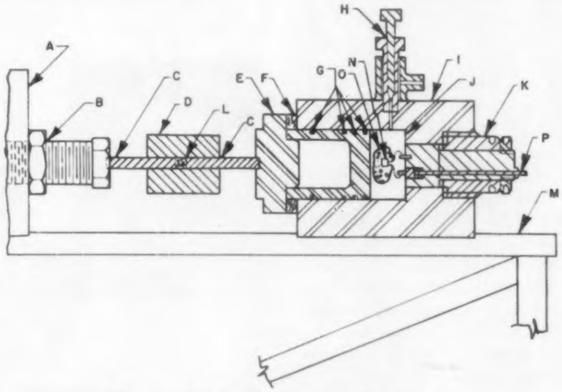

Fig. 1.—Schematic diagram of activator.

A—Backstop	*I*—Housing
B—Screwjack	*J*—Firing chamber
C—Punch	*K*—Firing head
D—Cylinder	*L*—Explosive specimen
E—Piston	*M*—Stand
F—Rubber bumper	*N*—Squib
G—Compression rings	*O*—Propellant bag
H—Needle valve assembly	*P*—Firing contact

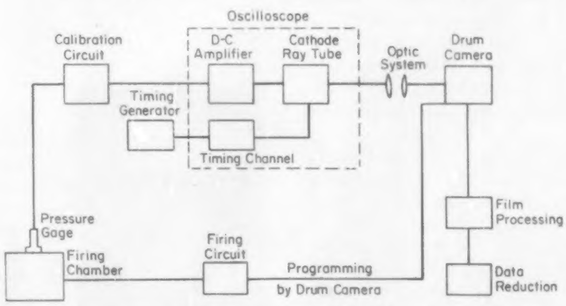

Fig. 2.—Pressure recording equipment used with devices for simulating gun firing.

[3] An item designed for electrical firing of burning-type munitions, consisting essentially of a tube containing a flammable material and a small charge of powder compressed around a fine resistance wire connected to electrical leads or terminals.

Theoretically, pressures or forces of almost any magnitude can be developed, subject only to the practical limitations imposed by the physical size of the equipment, the propellant characteristics, and the strength of the construction materials. Pressures produced by a relatively slow burning propellant are shown in the following table:

Weight of Propellant, g	Chamber Pressure, psi[a]	Pressure Applied Against Specimen, psi
1	1300	46 800
2	2300	82 800
3	3400	122 400
4	5000	180 000

[a] Average values.

For these firings, the pressure-rise time is a function of the chamber pressure, and ranges between 1 and 4 millisec.

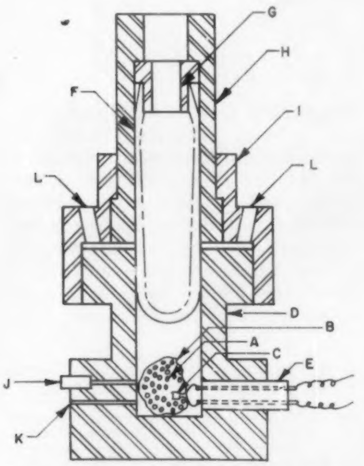

Fig. 3.—Schematic diagram of device which simulates gun-firing pressure on base of shell.

A—Propellant
B—Propellant bag
C—Squib
D—Test chamber
E—Firing head
F—Specimen
G—Plug
H—Sleeve
I—Nut
J—Pressure gage
K—Needle valve or constant opening
L—Vents

Device to Simulate Gun-Firing Pressure on Base of Shell

This static testing device can be used to determine whether a specimen can withstand ultrahigh rates of loading. It makes possible the examination of shell metal parts under pressure conditions similar to those existing in guns. There is no other known nondestructive test of this type available for examining the bases of shells.

The elements of the static tester are shown in Fig. 3. It consists principally of a test chamber into which a propellant charge is inserted; a plug, sleeve, and nut to hold the test specimen firmly in position; and auxiliary components and instrumentation. There are no moving parts. The device is designed to prevent the specimen from moving when a sharp, high-pressure surge occurs and to maintain the pressure for a finite period of time before relieving it. The action of the hot propellant gases on the shell specimen simulates the conditions to which it is subjected when fired from a gun. This makes it readily possible to study the behavior of the shell under simulated firing conditions. Before this device was available, such studies could be made only by firing shells from guns.

The static test device may be used to subject a large variety of items to high propellant gas pressures under extremely high rates of loading. Pressures of 45,000 to 50,000 psi have been achieved at loading rates of 430 μ sec. By varying the weight of the propellant charge, the maximum pressure and the rise time to maximum pressure can be controlled to simulate closely the firing of a shell from a gun tube. The device can be readily modified to produce higher pressures and to accommodate any specimen of manageable size.

Up to now, the static test device has been used chiefly to test artillery shells. When used for such a purpose, the machine is operated as follows: The amount of propellant required to produce the desired pressure is weighed and poured into a cloth bag. An electric squib is inserted into the bag and the unit is attached to the firing head, which is then assembled into the test chamber. The specimen is placed in the test chamber, with a plug and a sleeve to keep it in rigid alignment. A nut is screwed down over the sleeve to hold the shell securely. This nut is vented so that gases which leak past the specimen can escape. When the propellant charge is fired, the gases from the burning propellant generate a pressure throughout the interior of the test chamber, including the base area of the specimen. The pressure-time curve is recorded with the same instrumentation used for the activator.

When the static test device is used to subject shells to gun-firing pressures, the pressure-time relationship occurring in the gun can be reproduced. The device can also be used to investigate other problems associated with the firing of artillery shells. For example, the bases of shells suspected of being permeable by hot propellant gases can be examined. The related problem of whether base plates on shells prevent gas leakage can also be resolved. Plug joints can be studied to determine whether propellant gases can leak past them, and, if so, how to prevent such leaks.

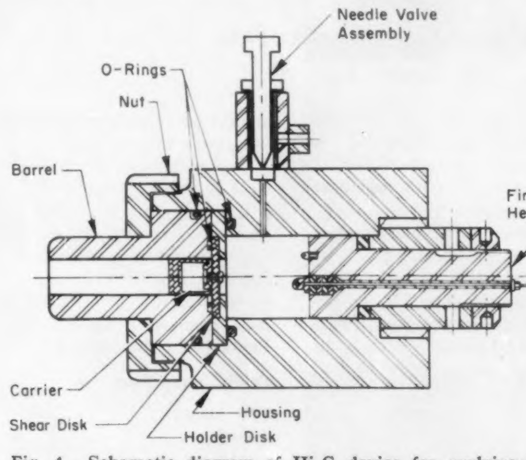

Fig. 4.—Schematic diagram of Hi-G device for applying high acceleration to small items.

As in the case of the activator, this static test device is not limited to use with artillery shells. It can also be used to study the effect of applying high pressures at high rates of loading to metallic and nonmetallic structural materials, the permeability of materials and joints under high pressures at ultrahigh rates of loading, and the mechanical behavior of structural materials in rapid compression.

When the static testing device is used to test items other than artillery shells, the procedure is identical except for the method of assembling the specimen to the machine. An adapter must be provided that will hold the specimen rigidly in place.

Hi-G Device

The Hi-G device (Fig. 4) has two purposes: (1) to subject small items to high accelerations, and (2) to propel such items at high velocities against armor plate. Its basic principle of

operation is the same as that of the activator and the static test device, that is, it uses the pressure of hot propellant gases as a source of energy. The test specimen is actually propelled by the gases in much the same way that a shell is propelled from a gun.

The Hi-G device provides, in much simpler, more flexible, and controllable form a means of subjecting items to be tested to the conditions that would be experienced in the drop or air-gun tests. The value of the Hi-G device becomes readily apparent when we consider that for small components it can eliminate the need for a drop tower or the elaborate compressor systems of the air gun, while at the same time retaining the advantages of these techniques.

The present Hi-G device has been designed to achieve an acceleration of 200,000 *g* and velocities greater than 2000 ft per sec. (Greater accelerations and velocities could be achieved with a heavier design.) The pressure in the propellant chamber, the diameter of the carrier, and the total weight of the carrier and its contents determine the acceleration reached. In addition, the volume of the propellant chamber and the length of the barrel determine the final velocity of the carrier.

Velocities are measured by firing through two screens. Chamber pressure is obtained from a gage in the chamber and recorded on a pressure-time trace by the same techniques that are used with the activator and the static tester.

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The Measurement of Relative Density of Sand

By SHIGERU KITAGO and FUMIWO KOZAKI

THE EXISTING standard methods of measuring maximum or minimum density of soils to establish their relative densities are not adequate for sandy or granular soils.

Last year, the authors undertook a field investigation on a simplified dynamic cone-penetration test in deep sand layers to examine the relation between penetration characteristics, shearing strength, and relative density of sand. This made it necessary to find the most suitable and practical method for determining the maximum and minimum densities of cohesionless soil, and several methods were tried, mainly based on the most recent report on this subject by the U. S. Bureau of Reclamation (1).[1]

In this paper, a proposal for a procedure to obtain maximum and minimum densities is presented, derived from the Bureau of Reclamation method (1), but more practical and easier to handle, because it eliminates the need for specially prepared apparatus and highly skilled operators.

Maximum Density Method

As a maximum density method for obtaining relative density of sandy soil, Tschebotarioff (2) tentatively recommends the use of the maximum value of the dry density by the Proctor test. The *Earth Manual* (3) suggests that the saturated soil itself be vibrated in the measure. H. C. Pettibone, C. W. Jones, and others (1) compared several vibrating methods, including the foregoing ones, and concluded that one should use oven-dried soil and a specially designed vibrating table.

The authors tried to establish a practical procedure that would require no expensive apparatus and would still yield good results, at least not inferior to those obtained with the Bureau of Reclamation method (1). At first, several existing procedures were examined in a manner similar to the Bureau of Reclamation investigations as follows:

Preliminary Test

Test Soils

Three kinds of pure sand were prepared, gradations of which are shown in Fig. 1. According to the Japan Industrial Standard, the particle diameter of sand is in the 0.05 to 2.0 mm range, and assuming that the difference in gradation must have great influence on the vibrating effect, these two extreme-graded sands (fine and coarse) and one well graded medium sand were selected. The specific gravity and uniformity coefficient values are noted in Table I, which shows a low value of the uniformity coefficient for fine and coarse sands.

TABLE I.—SPECIFIC GRAVITY AND UNIFORMITY COEFFICIENT OF SANDS.

Sand	Fine	Medium	Coarse
Specific gravity	2.846	2.759	2.747
Uniformity coefficient	1.66	3.60	2.08

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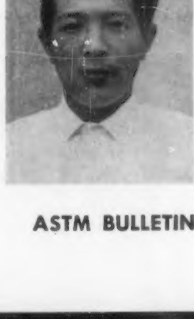

FUMIWO KOZAKI has been a highway engineer for the Yamashina Construction Office, Nagoya-Kobe Expressway, Kyoto, Japan Highway Public Corp. since 1959. Having been graduated in 1958 from the Muroran University of Engineering, he was appointed an assistant in the Civil Engineering Dept. of Hokkaido University in 1958, specializing in soil mechanics.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

TABLE II.—METHODS OF EXPERIMENT IN TEST PROCEDURE 3 (SATURATED SAND).

Test	Number of Layers	Movement of Vibrating Cylinder		Period of Vibration per Layer, min	
		Stationary	Moving Around the Periphery	Period per Point	Period per Round
No. 1	1	5 points	...	1	...
No. 2	2	5 points	...	0.5	...
No. 3	1	...	2 times	...	3
No. 4	2	...	2 times	...	3
No. 5	3	...	2 times	...	3
No. 6	[a]	...	Continuously during 9 min	...	Total 9

[a] Sample was poured in 9 min continuously.

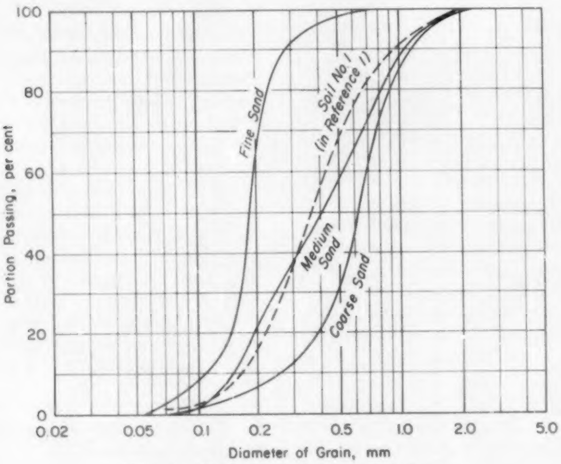

Fig. 1.—Gradation of the test sands.

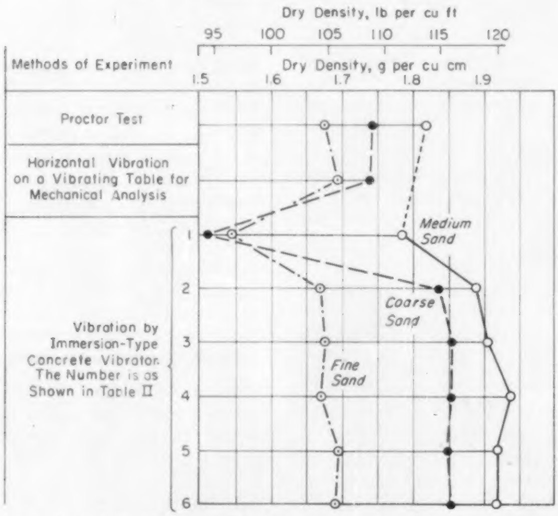

Fig. 3. Preliminary results of the three soil-compaction tests.

Test Procedure

Three methods of soil compaction were followed:

1. The Proctor test (U. S. Bureau of Reclamation).

2. Horizontally vibrating the mold (California Bearing Ratio mold 17.5 cm high and 15 cm in diameter, except where noted) full of saturated soil, fixed on a conventional vibrating device that is used for mechanical analysis of sandy soil. In the above procedure, data were taken both where overflowing of sands was allowed and where it was not allowed.

3. Vibrating the saturated sand directly in the mold with a concrete vibrator of the immersion type, with a vibrating cylinder 2.5 cm in diameter, 45 cm long, and at a speed of 6000 rpm (see Fig. 2). The period of vibration, movement of vibrating cylinder, and number of sand layers were varied as in Table II.

Results and Discussion

The test results are shown in Fig. 3, in which the optimum water contents are 15.5 per cent for fine sand, 13.0 per cent for medium sand, and 16.3 per cent for coarse sand.

A comparison of the results of the Proctor test with those of the vibration method demonstrated that the measured dry density by the vibration method was always larger than that by the impact-compaction Proctor method. It was clear that the vibration method was better than the impact method. Among the vibration procedures, tests

Fig. 2.—Vibrator, mold, and surcharges.

Nos. 2 to 6 in Table II gave almost similar values, and tests Nos. 4 or 5 were preferable.

Final Test

Test soils used were the same as those used in the preliminary test, but oven-dried. The test procedure in this test used surcharges (2.5, 5, 7.5, 10-kg weight, Fig. 2), and vibration was given only by the immersion-type concrete vibrator (Fig. 2).

Fig. 4.—Vibration of sand with 5-kg surcharge.

The test was classified in three categories as follows:

1. For the purpose of comparison with the preliminary test procedure 3, with saturated sand, several similar procedures were applied to oven-dried materials without surcharges.

2. As a special case of category 1, the vibration time was varied from 3 to 10

TABLE III.—COMPARISON OF DENSITY OF OVEN-DRIED AND SATURATED SAND USING VIBRATION METHOD.

Moisture Condition	Method of Vibration	Density, lb per cu ft (g per cu cm)		
		Fine Sand	Medium Sand	Coarse Sand
Dry	One-layer, one-point, in 3 min	107.5 (1.724)	120.4 (1.930)	114.8 (1.841)
	One-layer, three points, in 2 min	106 (1.698)	120 (1.922)	114.8 (1.841)
	Three layers, run around 2 times in 3 min for each layer	105.3 (1.689)	119 (1.908)	113.8 (1.821)
Saturated	Maximum value in all methods	105.9 (1.697)	121 (1.938)	115.9 (1.856)

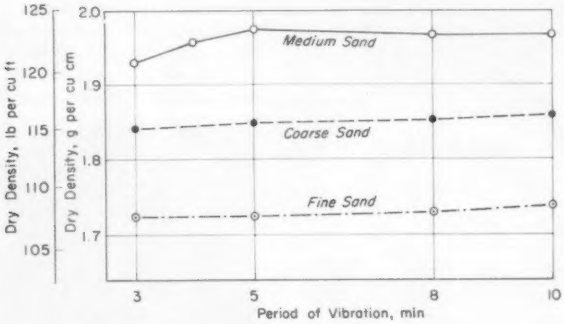

Fig. 5.—Effect of time (without surcharge).

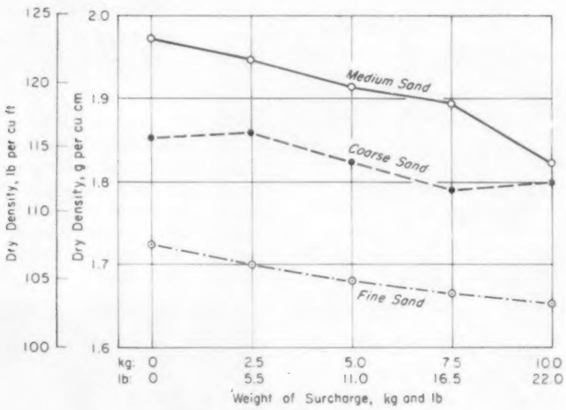

Fig. 6.—Tests results (category 3(a)).

TABLE IV.—COMPARISON OF VALUES FROM CATEGORY 3(*b*) AND CATEGORY 2 TESTS.

Surcharge, kg	Percentage of Dry Density (Category 3(*b*))				Percentage of Dry Density	
	2.5	5	7.5	10	5 min Vibration Without Surcharge (Category 2)	Proctor Method
Fine sand	98.9	100	98.6	99.2	97.5	94.6
Medium sand	100	99.3	99.4	99.4	99.6	91.8
Coarse sand	99.4	99.4	100	98.7	98.8	93.3

min to investigate the relation between the period of vibration and the dry density without surcharge.

3. Surcharge was applied in two ways:

(*a*) From the beginning of the test, and

(*b*) During the latter half of the vibration period of 8 min. The weight of the surcharge was varied from 2.5 to 10 kg, to observe the effect of surcharge weight and its method of application (Fig. 4).

Results and Discussion

Results of category 1 tests are indicated in Table III. This table shows that the vibration of saturated sand gave a value almost equal to that of dry material, although one might expect more compaction with dry sand. Among the dry methods, the one-layer, one-point procedure could be considered most effective. This fact led to a decision that the one-layer, one-point vibration was sufficient for the investigation of time effect of vibration without surcharge, namely category 2.

The results for category 2 tests are given in Fig. 5, from which it was concluded that the dry density became maximum in about 5 min and that time effect was dominant in well graded sand. It should be noted that the maximum density for each sand in Fig. 5 was larger than that obtained by vibration of saturated sand, and a more efficient value might be obtained by application of surcharge to dry sand.

Figure 6 shows the results of category 3(*a*) tests, and Fig. 7 shows the results of category 3(*b*) tests. The period of vibration in the category 3(*a*) tests was 5 min. According to Fig. 6, the dry density could be said to be inversely proportional to the weight of surcharge, if this be applied from the beginning of the test on oven-dried materials with a constant time of vibration.

Figure 7 shows the results of category 3(*b*) tests, which were aimed to obtain the largest possible density by this kind of vibration; the Bureau of Reclamation test procedure (1) was followed, because the results of tests in categories 1 and 2 indicated that 4 to 5 min of vibration was adequate for all sands to reach their maximum density with or

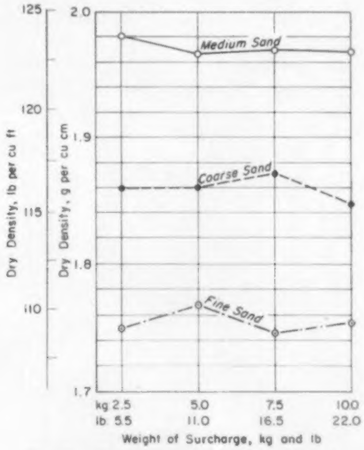

Fig. 7.—Tests results (category 3(b)).

without surcharge. By vibrating for the first half of the period without surcharge, the test material would be compacted to nearly its densest state; and by adding the surcharge for the latter half, its dry density would arrive at its maximum possible value. Figure 7 indicates that the maximum dry density was obtained in this test series when the weight of surcharge was 5.0 kg for fine sand, 2.5 kg for medium, and 7.5 kg for coarse. The values of density obtained by other weights of surcharge were nearly equal to these maximum values and also to the value secured by vibration without surcharge in 5 min. In Table IV, the relative values are shown, using an arbitrary figure of 100 for the maximum value obtained at each weight of surcharge in category 3(*b*) tests.

TABLE V.—COMPARISON OF VOID RATIO AND POROSITY.

Property	Present Investigation	U. S. Bureau of Reclamation Method (1)		
		Assumed Specific Gravity		
		2.6	2.7	2.8
Measured maximum dry density, lb per cu ft (g per cu cm)	123.7 (1.981)	111.6 (1.785)	111.6 (1.785)	111.6 (1.785)
Minimum void ratio	0.394	0.455	0.511	0.569
Minimum porosity, per cent	28.3	31.3	33.8	36.3
Measured minimum dry density, lb per cu ft (g per cu cm)	98.3 (1.573)	91.5 (1.464)	91.5 (1.464)	91.5 (1.464)
Maximum void ratio	0.753	0.777	0.846	0.914
Maximum porosity, per cent	42.9	43.7	45.9	47.8

TABLE VI.—DRY DENSITY FROM DISH AND FUNNEL METHODS, LB PER CU FT (G PER CU CM).

Sand	Fine	Medium	Coarse
Dish method	84.7 (1.360)	98.2 (1.573)	98.2 (1.573)
Funnel method	87.4 (1.400)	104.5 (1.676)	100.8 (1.613)

In Table IV it is shown that the vibrating effect of category 2 tests was enough to obtain the approximate maximum dry density and that the values given by the Proctor method were much smaller. It was also concluded from this fact that the Bureau of Reclamation committee (1) had omitted the alternate method of 4-min vibration with surcharge after 4-min vibration without surcharge.

The Bureau of Reclamation soil No. 1 (1), a natural fine sand, was similar to the medium sand of this investigation in grading as shown in Fig. 1, but the results could not be compared, because the specific gravity was not given in the Bureau report (1), and so its void ratio, e_{min}, and porosity, n_{min}, could not be found. With the specific gravity of the soil No. 1 assumed as 2.6, 2.7, and 2.8, the void ratio and porosity were calculated as indicated in Table V. In Table V the values of minimum density are also shown, which will be explained later.

The porosities of the materials used in the present experiments were smaller than those from reference (1), in both maximum- and minimum-density tests. This means that the measured densities were larger than those of the Bureau, which might arise from the slight difference in grading of grain size or the surface conditions of soil particles.

Table V also shows that the maximum density obtainable by the laboratory test procedures could be attained using the simple procedure and inexpensive equipment such as the test procedure of category 1 and a concrete vibrator in common use, if a little allowance in maximum value of dry density be permitted.

Minimum Density Method

The Bureau of Reclamation (1) used a spout to pour the sand as loosely as possible into the measure. J. J. Kolbuszewski (4) found that minimum densities were secured by pouring the sand rapidly into water. He also found that placing 1000 g of sand into a 2000-ml glass cylinder, inserting a rubber stopper, upending the cylinder once and then returning it quickly to its original position gave minimum densities comparable with those secured by the rapid-inundation method. The glass-cylinder method was recommended.

The authors have tried to use an evaporating dish and metal funnel instead of the spout to compare the test results with those of the Bureau.

Test Procedure

The equipment included two sets each of a measure (California Bearing Ratio mold), evaporating dish, and funnel. The dish was small enough to place the sand as gently as possible by hand in every part of the measure. Thus the drop-height of sand was almost zero; however, care was taken not to press the placed sand and not to strike the measure until the weighing was over.

The funnel had an 0.8-cm outlet diameter, and the sand was spread gently in a spiral motion, during which the drop height was made as small as possible and the same care was taken as before.

Test Results and Discussion

Table VI shows the test results and a comparison with the values obtained by the spout method as shown in Table V. For all sands, the dish method was superior to the funnel method. Furthermore, Table V shows that the minimum value of dry density was not much larger than that in the Bureau of Reclamation report (1). Little personal error is introduced in this method if the above-described precautions are taken.

Bulking of Sand

It is a well known fact that sand bulks when it absorbs a small amount of moisture. According to Terzaghi (5), a sand may increase in volume as much as 20 to 30 per cent. The dry density in this case would be far smaller than that obtained by the spout or the dish method.

TABLE VII.—EFFECT OF BULKING ON DRY DENSITY

Sand	Bulking		Dish Method
	Dry Density, lb per cu ft (g per cu cm)	Water Content, per cent	Dry Density, lb per cu ft (g per cu cm)
Fine	71.1 (1.14)	9.3	84.8 (1.36)
Medium	56.7 (0.91)	9.7	97.9 (1.57)
Coarse	72.3 (1.16)	4.6	97.9 (1.57)

The results of an investigation on dry density when bulked are shown in Table VII. In this test, the water content was increased step-by-step, starting from the oven-dried condition, and the moistened sands were carefully placed in the Proctor mold by hand (Fig. 8). Table VII shows that the dry density due to bulking was as much as 16 to 42 per cent smaller than that obtained in the dish method.

If the minimum density be defined as the minimum value of density that possibly exists by any method, that is, the loosest possible sand structure, this bulking density should be used instead of the above-mentioned value, regardless of its meaning in mechanics of soils. Relative density calculated under such a definition of minimum density would be considered correct as it is, because the determination of the minimum density in such a manner can be considered to satisfy the definition of relative density, and confusion will not occur, if either of them is designated.

Fig. 8.—Dish method.

However, the spout or the dish method is regarded by the authors as preferable to the bulking method because: (1) the spout or the dish method is easier to handle and gives less chance of mistakes than the bulking method, and (2) bulking would not occur in natural soil condition except in the surface portion of the earth of very

small depth, and so it follows that this special condition of soil could be neglected, if the discussion is limited only to the problems of soil mechanics (2, 5).

Table V shows the comparison of the dish method with that of the Bureau of Reclamation method (1). It shows that this easy-handling dish method gave good results, at least not inferior to the spout method, if the kind of soil is limited to pure sand.

Conclusion

Considering the results of this investigation, the recommendation offered by the Bureau of Reclamation (1) was accepted, save for the test equipment of the vibrating table, which is expensive and not always available. Oven-dried material is easy to handle, and the one-layer, one-point method of vibration with a concrete vibrator without surcharge is believed to give satisfactory results for maximum density values.

On minimum density, the present authors completely agree with the Bureau of Reclamation method (1). Either the spout or the dish method will serve the purpose, and the size of the California Bearing Ratio mold is large enough for determining both the maximum and minimum density of pure sand, the average diameter of which is 0.05 to 2.0 mm.

Acknowledgment:

The authors are deeply indebted to W. H. Price, Chief, Division of Engineering Laboratories, U. S. Bureau of Reclamation, who kindly sent us the laboratory report (1) at our request, which had encouraged us to undertake these investigations.

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(4) J. J. Kolbuszewski, "An Experimental Study of the Maximum and Minimum Porosities of Sands," *Proceedings*, Second International Conference on Soil Mechanics and Foundation Engineering, Vol. I, p. 158 (1948).

(5) K. Terzaghi and R. B. Peck, "Soil Mechanics in Engineering Practice," John Wiley & Sons, New York, N. Y., p. 118 (1948).

DISCUSSION

C. W. Jones.[1]—The Bureau of Reclamation has been a participant in a cooperative ASTM study of the relative density of cohesionless soils. A comparison of the results of this study has been presented by E. J. Felt in a paper published by ASTM in *STP No. 239*.[2] The cooperative work consisted of laboratory tests on six typical cohesionless soils by eight different agencies using equipment and procedures suggested by each.

During the cooperative test program by the Bureau, preliminary tests were made using various vibration methods. Among them was one similar in principle to that proposed in the paper by Messrs. Kitago and Kozaki. Several tests were conducted in which a medium-to-coarse sand was vibrated in a 0.1-cu-ft mold by a small immersion-type concrete vibrator. The average result obtained by this method was about 2.5 lb per cu ft less than that obtained by the vibratory table method which we tentatively adopted as an alternate method in Bureau work.

In order to have additional comparisons for this discussion, a few more tests have been conducted recently. A fine-to-medium sand in oven-dry condition was vibrated in a California bearing ratio mold while the concrete vibrator was held in the center of the specimen for a 3-min period. The resulting density was 113.3 lb per cu ft. For the vibratory table method with 3 psi surcharge on the specimen in a 0.1-cu-ft mold, the corresponding results were 110.5 lb per cu ft dry, and 114.2 lb per cu ft wet.

In Bureau work, it has been considered necessary to conduct relative density tests on soils containing 3-in. maximum-size gravel. For this, our new vibratory method specifies a 0.5-cu-ft mold and a 2-psi surcharge. Using the vibratory table method on a dry, well-graded gravel with a 1-psi surcharge, we obtained a density of 138.2 lb per cu ft. More surcharge would probably have given an even higher density. Using the concrete vibrator on this same material in the 0.5-cu-ft mold, we obtained a density of 133.1 lb per cu ft. By filling in the voids on top of the vibrated specimen with fine soil particles, the density was increased to 135.2 lb per cu ft.

Although the tests mentioned above were few in number, our conclusions are as follows:

1. The method of Messrs. Kitago and Kozaki, which has the advantage of a simple procedure using generally available equipment, is good for use in predominantly sandy soils if the highest maximum density is not considered necessary. It is our opinion that the maximum density obtained by the test procedure must be near the maximum possible density to conform to relative density concepts in design and construction control.

2. For a method to be used with a wide range of soils including gravelly types, and where a maximum practicable density is required, we believe that a vibratory table method using surcharge weights offers more promise.

Shigeru Kitago (*author*).—We are obliged to pay respects to the Bureau of Reclamation and to its participation in the cooperative studies to determine the maximum or minimum density of soils. To our regret, almost nothing has been done on this problem in our country, and a standardized method of procedure to obtain relative density of soil is not yet established. We also thank Mr. Jones for his discussion of an additional experiment to verify our conclusion on the test procedure to determine maximum density.

During the laboratory experiments for our paper, it was thought that the highest maximum density of a sandy soil that had been naturally deposited by various forces could almost never be reached by any artificial compacting method in the laboratory. If this should be true, the maximum density attained by any artificial method might merely have a relative meaning, and then the practical object, to determine a relative density, can be achieved as long as a suitable method for it is fixed. Such a method ought to be easily prepared and simple to operate for practical use both in field and laboratory. From these considerations, our method of test as mentioned in our paper has been proposed, although it is similar to one of the methods undertaken by the Bureau.

The first conclusion of Mr. Jones on predominantly sandy soils seems to agree with ours, and also seems to be in accord with our thoughts on practical determination of relative density.

With regard to Mr. Jones' second conclusion, test methods for gravelly soils were not aimed at in our investigation.

[1] Material engineer, Earth Laboratory, U. S. Bureau of Reclamation, Denver, Colo.

[2] E. J. Felt, "Laboratory Methods of Compacting Granular Soils," Symposium on Application of Soil Testing in Highway Design and Construction, Am. Soc. Testing Mats., p. 89 (1959). (Issued as separate publication *ASTM STP No. 239*.)

Development of Improved Insulating Oils

By N. W. FURBY and F. J. HANLY

Development of insulating oils presents petroleum refiners with unique problems. These include the need for rare crude oils, controversial bench test performance criteria, and very slow accumulation of field performance data. The service environment of insulating oils, involving years of soaking the oil in many organic insulation materials, is greatly different from that of other industrial oils. Performance requirements and criteria of oil condition and stability are discussed. A large number of bench stability test methods are summarized in Table I. An unpublished test method—the California Research Transformer Oil Stability Test—is described. By using this test, improved inhibited insulating oils several times more stable than conventional products were developed. Metal deactivators were very effective, and synergistic combinations of inhibitors were found. The data show that insulating oils substantially more stable than those currently used can be commercially produced. Development and use of such products are retarded by the apparent desire of the electrical industry to standardize on composition-type specifications.

INSULATING oils present unique problems to one developing industrial products from petroleum. These problems begin with the rather strict requirement for a suitable low wax content (naphthenic) crude. Relatively few refiners have such a crude available. A second problem is that of deciding upon the real service requirements of insulating oils, especially as related to bench test criteria. There is no question regarding the desire for "high" quality, but there is great difference of opinion among users as to how this is measured in short-time tests. The long life (up to 30 yr) of insulating oils in some types of service complicates this situation. A third major problem is the desire of the electrical industry to standardize types of insulating oil, thus tending to remove incentive for further research toward oil improvement.

Performance Requirements

The environment of insulating oils in service is unique as compared to other uses for refined petroleum fractions. The main difference is in the type and variety of substances contacted. Most petroleum-derived products, throughout their useful lives, are contained in metal (usually steel) vessels with only relatively small exposure to organic materials such as rubber seals. In contrast, electrical equipment using insulating oils, expecially transformers, contains scores of organic insulating and coating materials. These include wood, resins, paints, plastics, fabrics (natural and synthetic), and many others. These literally "soak" in the insulating oil continuously for years. The oil leaches soluble components from some of these (probably from most) and has its properties changed thereby. This fact alone is enough to invalidate some of the property criteria proposed for judging the potential life of used oils, as will be discussed below. Solvent power of oils for organic type solid insulation has been studied by Treanor and Raab (1)[1] and considerable variations in interaction for different oils and solid materials were noted. To the best of our knowledge, no one has used solvent power of the oil as an important variable in oil development because of the overriding importance of other requirements.

Service conditions for insulating oil have, in general, become more severe in recent years. This has resulted from the use of smaller equipment for a given load, made possible by the development of components capable of higher operating temperatures. This saves money and equipment space, but materials of construction are more severely stressed. Concurrent with this trend have come methods of protecting internal components by exclusion of air (oxygen), such as sealed cases for small equipment and for large transformers, "conservator"-type auxiliary expansion tanks, and inert gas blanketing. Theoretically, if air could be excluded from insulating oil, essentially the only deterioration occurring during use would be that caused by contaminants leached from the solid insulation. In practice, however, air-exclusion methods are not perfect. The problem is greatest for pole-type distribution transformers, in which large temperature fluctuations and frequent opening of handhole covers may admit excessive air. The industry appears to agree that this use is the most demanding on oil stability and, indeed, may be the only use where the more costly inhibited oils can be justified on a technical basis. However, several factors, including increased cost of handling more than one oil and mistaken selection of oil where more than one is available, have resulted in increased use of the inhibited oils.

The perfect insulating oil would not change at all during use. The changes

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[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

that do occur, with adverse effect on transformer performance, include the following:

1. *Sludging*.—Sludge formation hampers the cooling function of the oil. By thermal-insulation effect and restriction of flow, operating temperatures are increased, and deterioration of the oil is accelerated.

2. *Formation of Corrosive Oxidation Products*.—Peroxides and acids can cause rapid deterioration of organic insulating materials, especially fabrics. Other soluble oxidation products are also formed.

3. *Loss of Electrical Properties*.—Corrosion oxidation products adversely affect power factor, dissipation factor, and dielectric strength.

These are the three principal harmful effects of oil deterioration. Other changes in properties may or may not be related to these three and, therefore, to usefulness of the oil, as discussed below.

Criteria of Oil Condition and Stability

Field Practice

Utility companies use several criteria for condition of oil in field service. Their order of relative importance of properties has changed as transformer technology has developed. Also, selection of criteria may be influenced by fads of the moment as new property-quality correlations are promoted. In a recent AIEE–ASTM survey (**2**) of utility companies representing a generating capacity of 70 million kw, the following order of decreasing importance was indicated:

1. dielectric strength,
2. acidity,
3. power factor (PF),
4. interfacial tension (IFT), and
5. color

As compared to an earlier survey, color moved from second to fifth place, and both PF and IFT moved upward. Only four replies (of 96 total) stressed sludge formation.

Certain properties of insulating oils have been used rather loosely as criteria of oil condition. Although these have been discussed in the past, caution in their use cannot be overstressed. The following are among those most abused:

Steam Emulsion (SE) Number.—This property is supposed to measure the presence of polar contaminants. It does so very poorly. In some cases, the SE number can be decreased by addition of a "contaminant" such as a petroleum sulfonate. Field test data have shown that SE number tends to level off at values of 40 to 70, and that there is no correlation with oil quality (**4**). The test itself has poor repeatability, the conditions employed do not relate to field conditions, and results do not correlate with other types of emulsion tests.

Interfacial Tension (IFT).—IFT is affected by all polar contaminants, regardless of source. Thus, a fresh oil, entirely unoxidized, will have its IFT lowered markedly by contamination or by leaching of substances from the solid insulation. Therefore, IFT should be used cautiously, since it is only an indirect measure of oil condition.

Laboratory Practice

In addition to tests normally applied to fresh (new) oil for manufacturing control, it is necessary to use accelerated aging tests to predict service life. These involve oxidation under conditions much more severe than those found in service. Some of the large number of such tests used over the years are listed in Table I. Criteria of failure include sludge formation, acidity, IFT, and quantity of oxygen absorbed. Table I shows the wide variety of combinations of test conditions that has been used in the long search for better bench tests. Correlation of such tests and properties with service performance is highly important but very difficult to establish. Subcommittee IV on Liquid Insulation of ASTM Committee D-9 (now Committee D-27) has made a major effort to obtain correlations through a 10-yr study of tests in 18 transformers. The results are given in several publications (**3, 4, 5**). Likewise, extensive studies of test variables, such as relative value of solid versus soluble copper catalyst, have been reported (**6, 7, 8**). The following conclusions appear to us to describe the present state of the art.

1. Bench tests must be used with caution in ranking oils with respect to relative behavior in service. Reversals in order can occur.

2. Bench tests are indispensable for developing improved oils.

3. Shortening of the test time can lower the correlation with service unless test acceleration can be obtained without distorting the balance among the relative effects of the aging factors.

4. Copper is a very important catalytic agent that tends to shorten the life of insulating oil and must be included in tests and in product improvement work.

California Research Transformer Oil Stability Test

On the basis of essentially similar considerations this test was devised in 1947. A stability test was desired which was less accelerated than pressure bomb tests and more flexible than the sludge accumulation test. The test described in the Appendix resulted. With only minor changes, the apparatus used is that of ASTM Method of Test for Oxidation Characteristics of Inhibited Steam-Turbine Oils (D 943–47T).[2] This apparatus is in the laboratories of most developers of petroleum products, and accessibility and familiarity are favorable factors. Test conditions are summarized below:

Sample	300 g
Temperature	250 F
Gas	Oxygen, 3 liters per hr
Catalysts	Copper wire: 14 gage; surface area, 450 sq cm. Iron: medium silicon transformer iron (USS Trancor 72), 112.5 sq cm.

[2] 1958 Book of ASTM Standards, Part 7, p. 428.

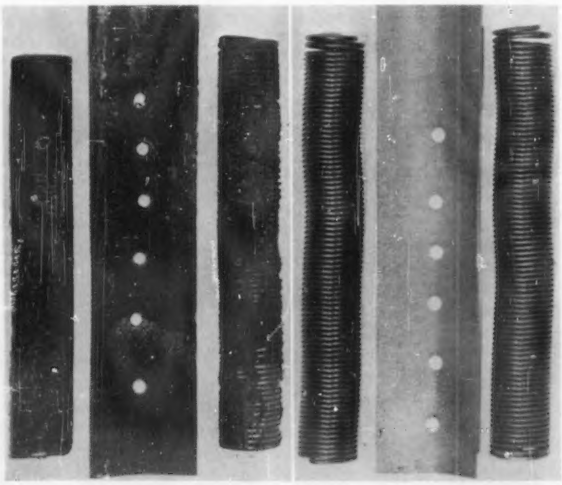

Fig. 1.—Catalyst strips and coils at end of California Research Transformer Oil Oxidation Test (strips and coils drained but unwashed).

(*left*) Uninhibited base oil A—test life, 24 hr; acid number, 1.0 mg KOH per g; oil insolubles at 75 F, 1.0 weight per cent. (*right*) Inhibited oil E—test life, 200 hr; acid number, 1.0 mg per KOH g; oil insolubles at 75 F, 0.21 weight per cent.

TABLE I.—TRANSFORMER OIL STABILITY TEST METHODS.

Method	Temperature	Duration	Oxidizing Medium	Catalyst	Container	Disposition of Oxidation Products	Criterion of Failure	Remarks
Snyder life test[a]	120 C (248 F)	0 to 50+ days	Air passed over surface	None	Glass	Escape	First visible sludge	Early sludge test, now obsolete
ASTM (D1314 – 54 T) sludge accumulation[b]	120 C (248 F)	72, 168, 336 hr	Dry air passed over surface	Small amount copper	Glass	Escape	Quantity of sludge	Oil not saturated with oxygen. Not good for inhibited oils
Line Material Co. method[c]	Cycled 40 to 100 F (104 to 212 F)	500+ cycles at 100 cycles per month	Limited air by breathing	Steel case and copper heater winding	Steel	Partially escape	Acid number, sludge, specific orientation, polarization	Mild test conditions
BSI sludge (Michie)[d]	150 C (302 F)	45 hr	Dry air saturation	Copper	Glass	Condensed retained and	Quantity of sludge	....
SOCAL, shaker oxidation test[e]	171 C (340 F)	0 to several hours	Oxygen	Copper	Glass	Retained	End of inhibition period by pressure drop	Useful for manufacture control
ASTM (D 1313 – 54) bomb sludge[b]	140 C (284 F)	24 hr	Oxygen at 250 psi	With or without a small amount copper	Glass	Retained	Quantity of sludge	Has appeared useful in past ASTM cooperative work
Shell Dev. oxygen absorption[a]	120 C (248 F)	Few days	Oxygen saturation	Large amount copper and iron	Glass	Removed	Oxygen absorption ~ 1000 cu cm NTP per 100 g	Indirect criterion, as oxidation products removed
Modified turbine oil test (TOOT)[f]	95 C (203 F)	200 to 3000+ hr	Oxygen saturation	Copper and iron, some water	Glass	Condensed and retained	Acid number = 1.0	Presence of water controversial
Cal Research transformer oil stability test[g]	121 C (250 F)	20 to 500 hr	Oxygen saturation	Large amount copper and iron	Glass	Condensed and retained	First sludge or insolubles, or acid number = 1.0	Discussed in this paper
Doble oxidation comparator[h]	95 C (203 F)	Based on property changes	Air	Copper and iron	Glass	Escape	IFT, acidity, sludge, power factor	Features continuous measurement of power factor
Weiss Salomon test[i]	115 C (239 F)	0 to 200 hr	Air	Copper	Glass	Escape	Sludge-time relationship	....
IEC test[j]	100 C (212 F)	164 hr	Oxygen	5 ppm each soluble copper and iron naph.				IEC test standardization. Awaiting more fundamental work
	110 C (230 F)	48 hr	Oxygen	20 ppm each soluble copper and iron naph.	Glass	Escape	Sludge	

[a] T. E. Reamer and R. G. Larsen, "Advantages of an Inhibited Transformer Oil," ASTM BULLETIN, No. 149, pp. 58–64, Dec., 1947.
[b] 1958 Book of ASTM Standards, Part 7, p. 735; Part 9, p. 912.
[c] R. W. Johnson, *Transactions*, Am. Inst. of Elect. Engrs., Vol. 74, pp. 774–780 (1955); M. I. Zwelling, *Electrical World*, Vol 134, p. 73 (1950).
[d] Methods BS 148 or IP 56/57, Standard Methods, Institute of Petroleum.
[e] Unpublished.
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[g] See Appendix I.
[h] "Double Telecasts Oil Power Factor Tests," *Electrical World*, Vol. 149, No. 8, p. 73, Feb. 24, 1958.
[i] T. Salomon, "The Performance Characteristics of Used Insulating Oils," Symposium on Evaluation of Insulating Oils—European Developments, Am. Soc. Testing Mats., p. 24 (1954). (Issued as separate publication *ASTM STP No. 172.*)
[j] H. Liander and G. Ericson, "Catalysts for Accelerated Aging Testing of Transformer Oil"; R. Irving and D. W. Bravey, "The Evaluation of Inhibited Transformer Oils," Symposium on Evaluation of Insulating Oils—European Developments Am. Soc. Testing Mats., pp. 1–56 (1954). (Issued as separate publication *ASTM STP No. 172.*)

Sampling.......	15 cu cm at 96 hr and each 24 hr thereafter to 240 hr, then each 48 hr to failure.
Criteria of failure.......	Minimum time to: 1. Acid number = 1.0, or 2. Deposition of sludge or cloud formation on cooling.

No specific correlations of results from this test with service tests have been made; however, it does rate oils in correct order based on known quality of commercial products.

Figure 1 shows catalyst strips at the end of the test. Typically, uninhibited oils form acid and sludge rapidly in this severe test. Oil E, after a test period eight times longer, is low in sludge. This product is discussed more fully below.

Development of Improved Products

Using the California Research test, extensive studies of relationships between stability and refinement were carried out. Many potential inhibitors and catalyst deactivators were evaluated. Several outstanding oils were developed on which patents were issued (**9, 10**). A part of this work is summarized in the following paragraphs.

Base Oils

It is well known that oil stability is very dependent on base oil source and refinement. The primary base oil used (oil A) was a product long recognized as one of the most stable insulating oils in the United States. Additional acid treatment was applied to this same base stock to make two base oils of successively higher refinement as listed below.

Base Oil	Unsulfonated Residue, Per Cent
A	90
B	95
C	98

Inhibitors

Primary.—Much work was done with the well-known phenolic inhibitor di-*tert*-butyl-*p*-cresol (DBPC). Organic selenides, whose effectiveness as antioxidants was first reported by our laboratory (**11**), were tested extensively. Other types of compounds screened included metal thiocarbamates, tetraphenyl tin, and certain esters known to have antioxidant qualities.

Secondary.—It was found that certain "coordination" compounds could chelate (form coordinate bonds) with the solid metal catalyst and thus profoundly reduce catalytic action. Some of these also remove soluble copper by precipitation. Many chelate compounds investigated were in the classes of anthraquinones, quinolines, phenones, phenols, benzoic acids, oximes, naphthols, and amino compounds. Among several showing effectiveness, the best was quinizarin (1, 4-dihydroxy anthraquinone) and was most used. Subsequent to the work described in this paper, others have reported studies of chelate agents in transformer oils (**12**)

Effects of Inhibitor Combinations

In addition to the separate effects of primary and secondary inhibitors, unexpectedly large benefits were obtained from certain three-component inhibitors, as will be described more fully later.

The inhibitors shown in the figures are identified as follows:

Inhibitor	Type
D	DBPC
S	Organic selenide
Q	Quinizarin

Experimental Results

Effect of Base Oil Refinement

The effect of base oil refinement is shown in Table II. Increased refinement produced oils less stable when uninhibited, but which responded better to inhibitors D and S. This is the effect normally found in refinement-stability-inhibitor-response relationships. These data reaffirmed the fact established in many earlier studies, that oil A was at optimum refinement for an uninhibited oil. (Less refinement produced earlier sludging.)

Effect of base oil refinement is discussed again below for blends containing two or more inhibitors.

Metal Deactivation.—Figure 2 shows that inhibitor Q is ineffective as a primary inhibitor when used alone, but it is very effective as a secondary inhibitor. These data indicate that the principal effect of the quinizarin is catalyst deactivation.

Blends with Inhibitor D.—Stability

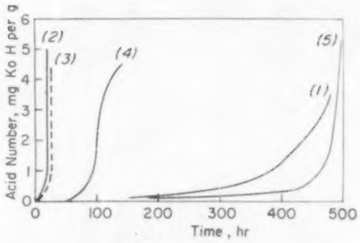

Fig. 2.—Effect of inhibitor Q on oxidation stability of oils.

Curve 1—Base oil A, uncatalyzed. Curve 2—Base oil A, catalyzed. Curve 3—Base oil A plus 0.05 per cent inhibitor Q, catalyzed. Curve 4—Base oil A plus 0.3 per cent inhibitor S, catalyzed. Curve 5—Base oil A plus 0.3 per cent inhibitor S plus 0.05 per cent inhibitor Q, catalyzed.

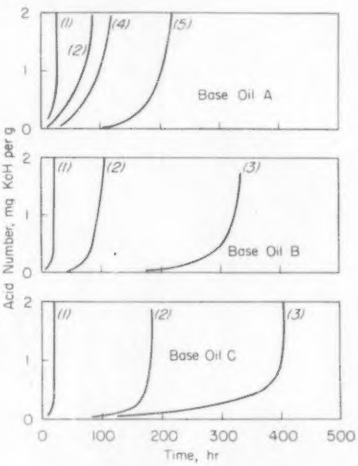

Fig. 3.—Blends with inhibitor D.

Curve 1—Base oil alone. Curve 2—Base oil plus 0.3 per cent inhibitor D. Curve 3—Base oil plus 0.3 per cent inhibitor D plus 0.05 per cent inhibitor Q. Curve 4—Base oil plus 0.5 per cent inhibitor D.

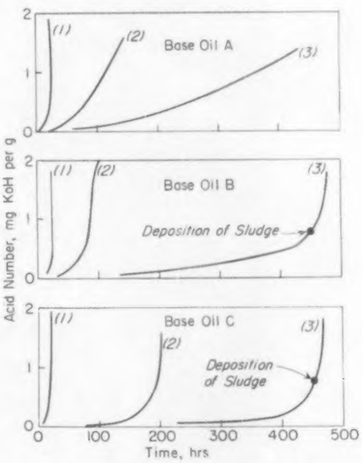

Fig. 4.—Blends with inhibitor S.

Curve 1—Base oil alone. Curve 2—Base oil plus 0.3 per cent inhibitor S. Curve 3—Base oil plus 0.3 per cent inhibitor S plus 0.05 per cent inhibitor Q.

TABLE II.—EFFECT OF BASE OIL REFINEMENT.

Inhibitor, (per cent by wt)	None	D (0.3)	S (0.3)	Q (0.05)
	Test Life, hr: California Research Method			
Oil Code:				
A (90 UR[a])	~24	70	115	~24
B (95 UR)	<24	95	...	<24
C (98 UR)	<24	180	200	<24

[a] Unsulfonated residue used as a measure of the degree of refinement.

results are given in Fig. 3. The very great effectiveness of inhibitor Q is shown. Also, note the "slow break" character of base oil A.

Blends with Inhibitor S.—Figure 4 summarizes results. The effects of the several variables are similar to those of Fig. 3. Inhibitor S is somewhat more effective than inhibitor D, especially in the lower-treated base oils.

Blends with Both Inhibitors D and S.—These are shown in Fig. 5. Marked synergism was shown at a ratio of inhibitors S:D of about 2:1. The synergistic effect increased with increased refinement.

Final Formulations.—Based on the foregoing work and taking into account economic cost factors on base oils and inhibitors, three formulations were chosen. Test data on these are shown in Fig. 6. Catalyst coils and strips for oils F and G are shown in Fig. 7. All three oils (E, F, G) were considerably more stable than a competitive commercial inhibited oil. In addition, oils E and G have "slow break" properties as compared to the competitive product, which employs a very highly refined base oil. Oils E and F contain two inhibitors in base oils of different refinement. Oil G utilizes a synergistic combination of three inhibitors.

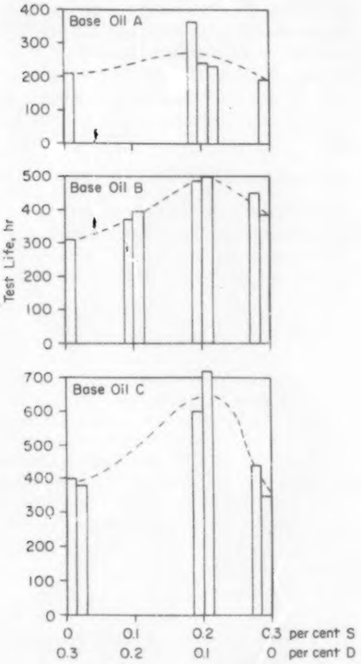

Fig. 5.—Synergistic combinations of inhibitors S and D. (All blends contain 0.05 per cent inhibitor Q.)

Commercial Exploitation

At the time these products were developed (1948 to 1950), Standard Oil Company of California did not market insulating oils directly to the consumer. Their customers, the equipment manufacturers, were made aware of the products described above. The products were acknowledged to be of outstanding quality, probably more stable than required. Also, the electrical industry decided to standardize throughout the country with one type on inhibited oil, made by adding 0.3 per cent DBPC to the current uninhibited oils. This was done to minimize storage and compatibility problems and to achieve uniformity.

Oil E was marketed for about three years. It gave excellent performance; the only problem, reported in one application, was the color of the oil ($3\frac{1}{2}$ ASTM),[3] which restricted visual examination of large filled transformers. The unique protection afforded by the presence of inhibitor Q in oil E was dramatically shown in one application in which oil E is still used and considered indispensable. This application is of enough interest to merit the following description:

An uninhibited oil, used to cool and electrically insulate the windings of the large electromagnet of a cyclotron particle accelerator, deteriorated to complete failure in approximately five years of service. In this application, 3000 gal of oil circulated from the electromagnet coil through an external water-cooled heat exchanger. The magnet coil, 150 tons of bare copper, was immersed in the oil. This amounted to a total of 18.3 sq ft of copper surface per gal of oil, compared to 5.3 sq ft in the accelerated California Research Transformer Oil Stability Test. The oil was required to maintain the temperature in the magnet coil below 55 C. Compared to fresh oil, the condition of the used oil is shown in Table III.

The first symptom of trouble was failure to maintain temperature below the allowable maximum. The heat exchanger was found to be plugged on

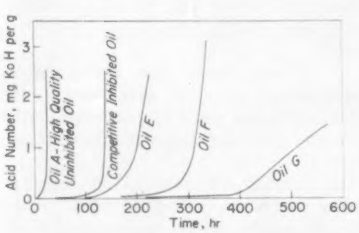

Fig. 6.—Oxidation stabilities of inhibited transformer oils (California Research Transformer Oil Stability Test).

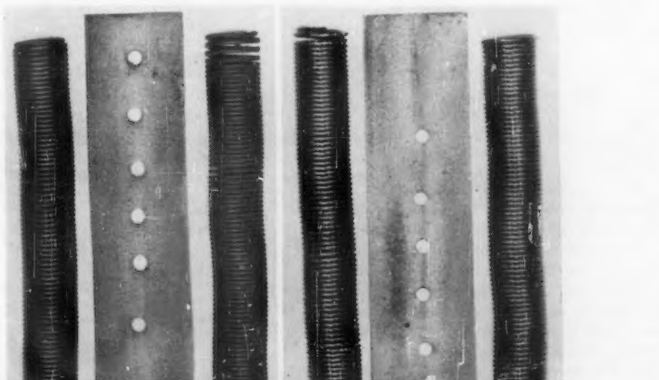

Fig. 7.—Inhibited transformer oils. Catalyst strips at end of California Research Transformer Oil Oxidation Test.

(*left*) Oil G—test life at 250 F, 510 hr; oil insolubles at 75 F, 0.37 weight per cent. (*right*) Oil F—test life at 250 F, 310 hr; oil insolubles at 75 F, 0.10 weight per cent.

TABLE III.—EFFECT OF CYCLOTRON SERVICE ON UNINHIBITED OIL.

Property	New Oil Specifications	Used Oil
Viscosity at 100 F, SSU	50 to 58	55.2
Neutralization number, mg KOH per g oil Federal Test Method Standard No. 5105.3	0.02 max	2.4
Interfacial tension, dynes per cm	40 min	10
Color, ASTM[3]	1 max	green
Spectrographic analysis	no metals	0.62 g copper per gal of oil

[3] Method of Test for Color of Lubricating Oil and Petrolatum by Means of ASTM Union Colorimeter (D 155 - 45 T), 1958 Book of ASTM Standards, Part 7, p. 90.

the oil side with a green slime that later was identified as a copper soap. This condition required complete chemical cleaning of the magnet coil tank, the heat exchanger, and all the circulating oil piping. Extensive cleaning was necessary to clear the oil-circulating passages and the heat exchanger, and also to eliminate the catalytic effect of the copper soap on the subsequent charge of fresh oil.

Following the cleaning job, an oxidation-inhibited oil containing an added copper deactivator (oil E) was installed. After a few days of operation, the new oil was inspected, with the following results:

1. There was an initial loss of 40 per cent of the copper deactivator. The loss was due to: (*a*) precipitation of the remaining soluble copper not removed by the cleaning process as shown by spectrographic analysis, and (*b*) direct absorption of the deactivator on the bare copper surface.

2. There was an initial drop in the interfacial tension to 26 dynes per cm from an initial value of well over 40.

Periodic inspections were made of the oil in the system. It was found that after three years, about 20 per cent of the copper deactivator still remained. After eight years, the oil still had an effective concentration of metal deactivator and showed no significant change in other properties.

It was concluded from these data that the metal deactivator not only removed all of the soluble copper from the oil but neutralized the catalytic effect of the large surface area of copper metal.

This is an example of extremely severe service not likely to be encountered in any conventional electrical transformer. It does demonstrate convincingly the magnitude of protection against oil deterioration that can be obtained by the selection of the proper base oil effectively inhibited.

Conclusions

The following conclusions relate to the development and use of insulating oils more stable than those presently used.

1. Inhibited oils far more stable than those currently used have been developed and could be made available commercially if demand should warrant it.

2. Present criteria of oil quality leave much to be desired because of: (*a*) Disagreement on interpretation of property-quality relationships, (*b*) Lack of universally accepted stability tests, and (*c*) Need for more field performance data as related to (*a*) and (*b*).

Subcommittee IV of ASTM Committee D-9 (now Committee D-27) has done excellent work for many years in this difficult area. It is hoped this work will continue, since it is badly needed.

3. The California Research Transformer Oil Stability Test is a practical and useful test for the development testing of high-performance insulating oil. Its time requirement is not excessive, its repeatability is good, it uses readily available materials and equipment, and the technique is simple.

4. The desire of the electrical industry as a whole to standardize on a composition type of specification for insulating oil discourages development of improved products. This policy is sound if no further improvement is needed, but it should be recognized that it greatly reduces incentive for research and development on insulating oils.

Acknowledgment:

The major contribution of Mr. C. D. Newnan is gratefully acknowledged.

APPENDIX

California Research Transformer Oil Stability Test

This accelerated oxidation test is intended to determine the relative oxidation stabilities of inhibited transformer oils and to detect the onset of sludge formation during the course of their oxidation.

Inhibited transformer oils are oxidized at 250 F in the presence of copper and iron catalysts in a system similar to that used in the ASTM Method of Test for Oxidation Characteristics of Inhibited Steam-Turbine Oils (D 943).[2] Progress of this catalyzed oxidation is followed by visual inspections of the test oil and of the catalyst surfaces and by the condition of samples removed at specified time intervals. Details of apparatus, catalysts, and sampling procedure are summarized in Fig. 8.

Apparatus

The oxidation is carried out in an oxidation cell equipped with water condenser as specified in ASTM Method D 943. The oxygen delivery tube, however, is a straight piece of 7-mm OD glass tubing extending to the bottom of the oxidation cell. This cell is maintained immersed to the oil level in a thermostatically controlled oil bath.

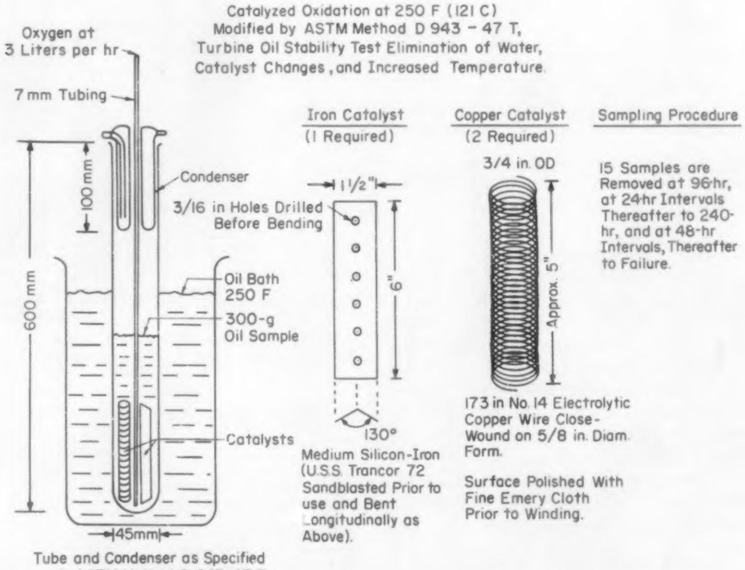

Fig. 8.—California Research Transformer Oil Stability Test.

Catalyst Details

Two copper coils and one iron strip are required. The iron and copper should be in contact during the test. It is imperative that these not be handled with the bare hands after surface preparation.

Copper Coil

One hundred seventy three in. of No. 14 electrolytic copper wire is carefully polished with fine emery cloth immediately prior to the test, then close-wound on a $\frac{3}{8}$-in. mandrel, similar to that shown in ASTM Method D 943, to form a coil approximately 5 in. long. Two coils are required.

Iron Strip

A $1\frac{1}{2}$ by 6-in. strip of medium silicon transformer iron (USS Trancor 72) is drilled with six $\frac{3}{16}$-in. holes and sandblasted with clean, dry sand immediately prior to use. To facilitate fitting this strip into the bottom of the oxidation cell with the two copper coils, it is bent longitudinally before sandblasting as shown in Fig. 8.

Test Procedure

Oxygen is bubbled at 3 ± 0.5 liter per hr through 300 g of test oil at 250 ± 2 F in the presence of 112.5 sq cm of medium silicon transformer iron (USS Trancor 72) and sufficient No. 14 gage electrolytic copper wire to present surface area of 450 sq cm. The copper coils should be in contact with the iron during the test.

Sampling Procedure

1. Visual inspections are made daily of the oils under test to note the appearance of sludge, turbidity, or insoluble products.

2. A 15-cu cm sample is withdrawn by pipet from each tube after 96 hr, at 24-hr intervals thereafter to 240 hr, and at 48-hr intervals thereafter to failure. On cooling to ambient temperature, the presence or absence of any insoluble oxidation products is noted; and the acid number is determined by titration with standard base to phenolphthalein end point.

Interpretation of Test Results

Test life of an oil is defined as the minimum time to:

1. Reach an acid number of 1.0, or
2. Show on visual examination any condition considered objectionable from a service standpoint, in particular: (*a*) deposition of sludge, or (*b*) formation of oxidation products that are insoluble on cooling to ambient temperature.

An arbitrary classification can be established for transformer oils on the basis of their test lives as follows:

Oil	Expected Test Life, hr
Uninhibited	<24
Low inhibitor content	75
Moderate inhibitor content	150
High inhibitor content	300

It is to be noted that the test becomes increasingly severe as the test life is extended, for the catalyst-oil ratios are increased with each 15-cu cm oil sample withdrawn.

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A Test Method for Air-Entrainment of Standard Ottawa Sand

By MARTIN R. DeFORE and HAROLD J. CORAH

Tests indicated that standard Ottawa sand from different lots contributed in varying degree to the amount of air entrained in the air-entrainment test for portland cement. Washing and drying the sand resulted in lower values for air-entrainment in cement-sand mortars, especially with nonair-entraining cements. The weights of 400-ml samples of sand-water mixtures were used to evaluate the air entraining properties of the sand. Studies of different methods of washing and drying the sand revealed a procedure whereby better reproducibility was obtained in the determination of the air content of the mortar. Repeated wetting and drying may be necessary. On the basis of these tests it appears that 400 ml of a mixture of washed standard sand with 25 per cent water should weigh at least 792 g when mixed and placed by standard test procedures.

IT HAS BEEN noted at two of the National Bureau of Standards field stations that the values for percentage air-entrainment of cements tested in accordance with standard specifications were dependent to some extent on the particular shipment of standard Ottawa sand that was used. Variations of results of this type could account for some of the differences encountered in interlaboratory tests or in differences of values obtained by a cement producer and a testing laboratory. No known systematic evaluation has been made of the contribution to air-entrainment made by the standard sand, nor are there any recognized test methods or specification requirements dealing with this property. It appeared desirable, therefore, to study this problem and to develop test methods and specification limits for the air-entrainment of the sand.

Materials

The standard Ottawa sand used in these tests conformed to the present specification for standard 20–30 sand and was produced by the Ottawa Silica Sand Co., Ottawa, Ill.

Sands A and B were purchased by the National Bureau of Standards laboratory at Denver, sand C, by NBS laboratory, Washington, D. C., sand D, by NBS, Seattle, and sand E, by NBS, San Francisco. Tests for any one series were made from the same bag of sand.

The cements used in these tests have been numbered 1 through 11. Each cement conformed to the present specifications for cement and was thoroughly blended before use. The type of each cement is indicated in the tables.

Test Methods

All air-entrainment tests of cement-sand mortars were made by procedures described in ASTM Method of Test for Air Content of Hydraulic Cement Mortar (C 185)[1] and Federal Test Method SS-C-158b, Method 2401.

Tests of the 400-ml sand-water mixtures were also made according to the standard test procedures as indicated above, except that the 30 sec normally allowed for mixing the cement and water was not included and no determinations were made of the percentage flow.

Various methods, as indicated in the text and tables, were used in washing and drying the standard sand to determine the effect of such treatment on the amount of air entrained in cement-sand mortar and in sand-water mixtures when placed in the measuring cup by standard procedures.

Effect of Different Sands on Air-Entrainment of Cement Sand Mortars

To demonstrate the effect of sand type on the percentage air-entrainment values for different cements, two series of tests were made. In the first series, tests were made of the percentage air-entrainment of six cements, Nos. 1 through 6, using sands A and B. Results of these tests are presented in Table I. Each value is the average of three or more tests. It may be noted that the use of sand B resulted in higher percentage air-entrainment values with each of the six cements than were obtained with sand A. The two sands appeared to react differently with the different cements; the difference in percentage air entrained obtained with the two sands ranged from 2.8 to 5.9 percentage points depending on the cement.

A second series of tests were made with three brands of portland cement Nos. 7 through 9, with sand B as received and with the same sand washed and dried in the laboratory. Vinsol resin, 0.9 ml of a 50-g per liter solution, was added to half of the mixtures to determine whether the effect of the sand was as great in air-entraining mortars as with regular cements without air-entraining properties. The results of triplicate tests are presented in Table II. With the three nonair-entraining cements, the use of washed sand resulted, in each case, in lower

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[1] 1958 Book of ASTM Standards, Part 4, p. 45.

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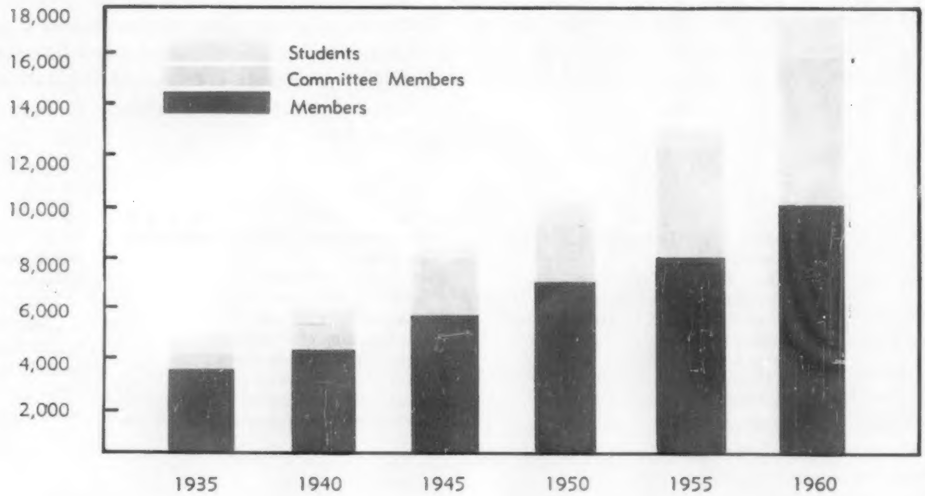

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*I*n view of the increasing importance of materials problems, ASTM must and will continue to progress. It has a sound financial foundation on which to build; for the current year, the annual budget will exceed $1,400,000. This is apart from the vast amount of research work supported by industry, government, and individuals, to provide data on materials.

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TABLE I.—PERCENTAGE AIR ENTRAINED IN 1:4 MORTARS MADE OF SIX CEMENTS WITH TWO LOTS OF STANDARD SAND.

Cement	Type	Air, per cent	Sand
1.......	I	4.4	A
1.......	I	9.4	B
2.......	II	4.1	A
2.......	II	9.0	B
3.......	Nat.	5.1	A
3.......	Nat.	11.0	B
4.......	I	5.1	A
4.......	I	8.9	B
5.......	II	4.1	A
5.......	II	8.8	B
6.......	I	6.3	A
6.......	I	9.1	B

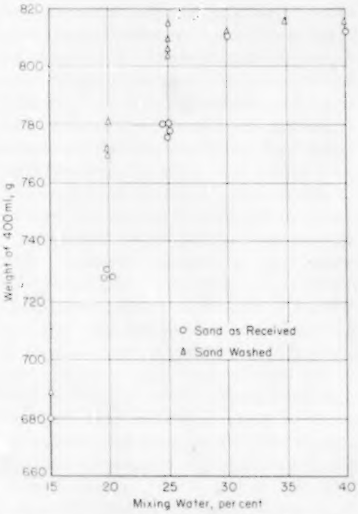

Fig. 1.—Comparison of weights of sand as received with washed sand.

TABLE II.—PERCENTAGE AIR ENTRAINED IN 1:4 MORTARS.

Mortars Made of Three Portland Cements With and Without Added Air-Entraining Agent Using Sand As Received and Sand After Washing and Drying.

Portland Cement	Type	Water, per cent	Flow, per cent	Weight of 400 ml of Mortar, g	Air, per cent	Sand B
7......	II	71	89	825	8.4	As received
7	II	71	93	819.5	9.0	As received
7......	II	71	95	825	9.0	As received
Averages................		71	92	823.2	8.60	
7......	II	71	92	851	5.5	Washed
7......	II	71	90	853.5	5.2	Washed
7......	II	71	90	853	5.3	Washed
Averages................		71	91	852.5	5.33	
7......	II-A	58	97	760.5	18.0	As received
7......	II-A	57	91	756.5	18.6	As received
7......	II-A	57	93	757.5	18.5	As received
Averages................		57	94	758.2	18.37	
7......	II-A	57	92	767.5	17.4	Washed
7......	II-A	57	92	768	17.4	Washed
7......	II-A	57	91	772	16.9	Washed
Averages................		57	92	769	17.23	
8......	I	71	84	815	9.5	As received
8......	I	71	89	813.5	9.6	As received
8......	I	71	85	817	9.3	As received
Averages................		71	86	815.2	9.47	
8......	I	71	88	833	7.5	Washed
8......	I	71	88	830	7.8	Washed
8......	I	71	88	834	7.4	Washed
Averages................		71	88	832.3	7.56	
8......	I-A	60	93	743	19.5	As received
8......	I-A	60	92	742.5	19.6	As received
8......	I-A	60	92	742.5	19.6	As received
Averages................		60	92	742.7	19.57	
8......	I-A	60	94	748	19.0	Washed
8......	I-A	60	95	748.5	18.9	Washed
8......	I-A	60	95	752	18.5	Washed
Averages................		60	95	749.5	18.80	
9......	II	72	85	816	9.2	As received
9......	II	72	87	813.5	9.4	As received
9......	II	72	90	818	8.9	As received
Averages................		72	87	815.8	9.17	
9......	II	72	83	818.5	8.9	Washed
9......	II	72	87	822.5	8.4	Washed
9......	II	72	86	822	8.5	Washed
Averages................		72	85	821.0	8.60	
9......	II-A	61	85	763	17.1	As received
9......	II-A	61	87	764.5	17.0	As received
9......	II-A	61	87	767	16.7	As received
Averages................		61	86	764.8	16.93	
9......	II-A	61	87	760.5	17.4	Washed
9......	II-A	61	87	767	16.7	Washed
9......	II-A	61	84	765	16.9	Washed
Averages................		61	86	764.2	17.00	

values for air-entrainment than did use of the sand as received. With the air-entraining agent added, mortars of two of the three cements made with the sand B as received had only slightly higher values for air-entrainment than was obtained after washing. With one cement, the average values for percentage air were about equal.

To help evaluate the contribution of the sand to the percentage air-entrainment values obtained, use was made of the 400-ml cylindrical measure used in the standard test. The test procedure consisted of mixing 1000 g of the 20–30 standard sand with known quantities of mixing water in a Hobart mixer in accordance with standard procedures, except that the 30 sec normally allowed for mixing the cement and water was not included. The 400-ml measure was filled with the sand-water mixture which was then spaded, tapped, the excess struck off, and the measure and contents weighed, all according to standard procedures. No determinations of percentage flow were made. The weight of 400 ml of the sand-water mixture was reported, and in some instances the percentage of air was calculated.

Several series of tests were made in this study. The first series consisted of determining the weight of 400 ml of the sand-water mixture using various percentages of water and using both standard 20–30 Ottawa sand as received and portions of the same lot of sand that had been "washed" and then dried. The "washing" consisted of adding tap water to about 2000 g of the sand in a 6-qt mixing bowl. The mixture was agitated with a spoon for 1 min, allowed to stand for 1 min, after which the water was decanted. This was repeated 4 times. The washed sand was then dried in a vented oven at approximately 50 C. The results of tests with the sand as received and the washed sand mixed with different percentages of water are presented in Fig. 1 and Table III. It was apparent to the operator that unwashed sand was more plastic and workable than the washed sand in the range of 15 to 30 per cent water content.

It may be noted from Fig. 1, when comparing the weights of the 400-ml sample of the sand-water mixes of the sand as received and as washed and dried, that the greatest difference in

TABLE III.—WEIGHT OF 400-ML SAMPLES OF SAND-WATER MIXTURES.

Sand[a]	Mixing Water, per cent by Weight of Sand	Weight of 400 ml, g	
		Sand "As Received"	Washed
B.....	15	679.5	688
B.....	19.8	732	772
B.....	19.8	728	771
B.....	25	780	806
B.....	30	811	811.5
B.....	35	...	816
B.....	40	812	816
C.....	20	730	782
C.....	25	781	810
D.....	25	776	805
E.....	25	782	815

[a] Sand B—from NBS Denver.
Sand C—from NBS Washington.
Sand D—from NBS Seattle.
Sand E—from NBS San Francisco.

weights occurred when 20 per cent water by weight was used. Some difficulty was encountered in properly filling the 400-ml measure when 20 per cent or less water was used in the mix. Using 25 per cent water by weight resulted in a more plastic, placeable mixture, and values which were more reproducible.

Also reported in Table III are the weights of 400-ml samples of sand-

TABLE IV.—SIEVE ANALYSIS AND PERCENTAGE AIR ENTRAINED IN STANDARD 1:4 CEMENT-SAND MORTARS AND IN SAND-WATER MIXTURES, SAND B.

Method of Treating Sand	Sieve Analysis		Standard 1:4 Cement-Sand-Mortar				Sand-Water Mixture		
	No. 30 Sieve, per cent passing	No. 20 Sieve, per cent retained	Mixing Water, per cent	Flow, per cent	Weight of 400-ml Mortar, g	Entrained Air, per cent	Mixing Water, per cent	Weight of 400-ml Sand-Water, g	Entrained Air, per cent
1.....	1.34	1.24	70	83	803.5	10.9	20	728.5	12.3
2.....	...	...	..	..	...	...	20	730	12.2
3.....	0.93	0.93	70	82	817.5	9.4	20	754.5	9.2
4.....	0.87	0.98	70	80	830.5	7.9	20	766	7.8
5.....	1.07	0.82	70	79	826.5	8.4	20	758.5	8.7
6.....	0.86	0.92	70	84	824.5	8.6	20	755	9.1

water mixtures made from different lots of sand from four NBS laboratories and using 25 per cent water by weight. As may be noted, sand from all of these lots entrained air when used as received, resulting in weights for the 400 ml of mixtures ranging from 776 to 782 g, whereas washed samples of these same lots of sand entrained less air. The weights of 400 ml of the washed sand with 25 per cent water ranged from 805 to 815 g. These tests were made in the Denver and Washington laboratories and by different operators.

The third series of tests consisted of a study of the effect of various methods for washing and drying the sand on the air content of both the sand-water mixes and cement-sand-water mixes. For the first group of tests, the following methods for treating the sand were investigated:

1. Sand used as received without washing or drying,
2. Dry sand heated in an oven at 66 C,
3. Sand washed four times and then dried at 30 C as in second test series, Nos. 7 through 9,
4. Sand covered with water, allowed to stand 1 min, then decanted and dried at 66 C, care being taken not to agitate the sand during the washing procedure,
5. 2000 g of sand placed in a Hobart mixer bowl filled with water and mixed for 5 min with additional water added to the mixing bowl throughout the mixing period. The water was then decanted and the sand dried at 66 C, and
6. Sand washed and dried as in (5) above except that a 30-min mixing cycle was used.

Tests were made in each case of the percentage of the sand retained on the No. 20 sieve and the percentage passing the No. 30 sieve to determine whether the washing procedures used resulted in a loss of fines or attrition of the sand particles. Tests were also made, using standard test procedures, of the percentage air-entrainment values obtained with a uniform sample of portland cement, and corresponding tests were made as described in the first series using sand-water mixes with 20 per cent water. The results of these tests are presented in Table IV.

TABLE V.—RESULTS OF SPECTROCHEMICAL ANALYSES OF RESIDUE FROM EVAPORATED WASH AND FROM TAP WATER.

Elements[a]	Wash Water Signal[b]	Tap Water Signal[b]
Al.........	S	M
B.........	T	VW
Ca.........	VS	VS
Co.........	VW	[c]
Cr.........	W	T
Fe.........	S	S
K.........	S	VS
Na.........	VS	VS
Ni.........	VW	T
Mg.........	S	S
Si.........	VS	S
Sn.........	VW	W
Sr.........	M	M
Ti.........	W	VW

[a] In addition, both samples gave T signals for Ag and Mo; W signals for Ba, Cu, Li, and Mn; and VW signals for Pb, Rb, V, Zn, and Zr.
[b] In general, VS, greater than 10 per cent; S, 1 to 10 per cent; M, 0.1 to 0.1 per cent; W, 0.01 to 0.1 per cent; VW, 0.001 to 0.01 per cent; T, 0.0001 to 0.0001 per cent.
[c] Not detected.

It may be noted that when using the sand as received or the sand heated dry (without wetting) considerably more air was entrained than when the sand was wetted or washed, and decanted, and then dried. In fact, simply wetting the sand, decanting, and then drying resulted in the lowest air-entrainment in both the cement mortar and the sand-water mixture. There appeared to be a fair relationship between the percentage air retained in the standard 1:4 cement-sand mortars and the percentage air retained in the respective sand-water mixtures.

The effect of washing on the percentage of the sand retained on the No. 20 sieve or passing the No. 30 sieve was slight and was not considered significant. However, further studies were made to determine whether some inorganic material was removed in the washing and decanting procedures used. The tap water used in washing 50 lb of standard 20–30 sand was evaporated to dryness at 200 F and spectrochemical analyses made on this residue and on the residue of an equal quantity of tap water evaporated in a similar manner. The results are presented in Table V. Although somewhat greater quantities of aluminum and silicon and smaller quantities of potassium were indicated in the residue from the washed sand than from the tap water residue another series of tests indicated that the inorganic salts themselves were probably not responsible for the air-entraining property of the sand. It was found, for example, that saturating the sand with water in the Hobart mixing bowl and drying without decanting also reduced the quantity of air entrained. It was also found that the quantity of air entrained was dependent on the temperature of drying of the wetted sand. The results of this series of tests are presented in Table VI.

Another series of tests were made using standard sand from a bag received in another shipment. Tests

TABLE VI.—EFFECTS OF VARIOUS METHODS OF WETTING AND DRYING SAND ON PERCENTAGE AIR-ENTRAINMENT.

Cement	Type	Mixing Water, per cent	Flow, per cent	Weight of 400-ml Mortar, g	Air Entrained, per cent	Treatment of Sand B
4........	II	71	86	821.5	8.8	[a]
5........	I	70	84	817	9.5	[a]
4........	II	71	82	848	5.8	[b]
5........	I	70	79	832	7.8	[b]
5........	I	71	84	832.5	7.5	[b]
4........	II	71	85	848	5.8	[c]
4........	II	71	85	831.5	7.6	[d]
4........	II	71	86	833	7.5	[d]
5........	I	71	82	823	8.6	[d]
4........	II	71	87	826	8.3	[e]

[a] 20–30 sand, no washing or drying.
[b] About 2000 g sand saturated in water and oven dried at approximately 70 C, no agitating or decanting.
[c] 1400 g sand saturated in water and oven dried at approximately 70 C, no agitating or decanting.
[d] Same as in footnote *c* except oven dried at approximately 32 C.
[e] A predetermined amount of mix water (71 per cent by weight of the cement) was added to 1400 g of 20–30 sand in a Hobart mixer bowl. The bowl was sealed with a plastic cover and rubber band and then placed in the oven as in method shown in footnote *d*. The bowl and contents were weighed before and after the drying period. A loss of 1.5 g of sand was noted in the drying cycle. The air-content determination was made by adding the cement to the sand and water and mixing. The standard mixing procedure was followed except that during the first minute of the mixing period, the sand, water, and cement were in the bowl.

were made of the effect of drying at 40, 70, and 105 C, and also the effect of repeating the wetting and drying treatment. The weight of 400-ml of the sand-water mixture using 25 per cent water was determined. The average of six values for this weight obtained with the sand as received was 784 g, with a standard deviation of 3.2 g. The other values, as presented in Fig. 2, are the results of single determinations.

It may be noted (1) that additional wetting and drying caused an increase in the weight of the 400-ml samples of the sand-water mixture, and (2) that drying at 105 C was more effective than drying at lower temperatures. It may be necessary, therefore, to repeat the wetting and drying of the sand to secure a sand that does not contribute to the air entrainment of the standard 1:4 cement mortar.

Conclusions

On the basis of these tests, it appears that more comparable results could be obtained by different laboratories if they all used standard sand that contributed equally to the air-entrainment of the standard mortar.

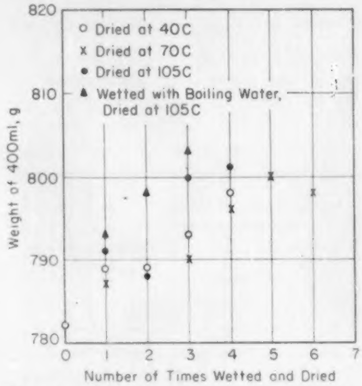

Fig. 2.—Values for sand-water mixture obtained for weight versus times wetted and dried.

The test procedures used in this study appear to offer a satisfactory means for determining the contribution of the sand to the air-entrainment values. Specifications for 20–30 Ottawa sand used for air-entrainment tests for portland cement should require that 400-ml of the washed sand-water mixtures made with 25 per cent water weigh at least 792 g.

We do not know the reason why some of the sand seems to entrain air, but it was found that wetting the sand with potable tap water and drying at 70 to 105 C removed the air-entraining characteristics. Washing and drying the sand should be done in the laboratory when necessary to control the air-entraining properties of the sand.

Technical Note

Additional Variables in the Brittleness Temperature Testing of Polyethylene

SEVERAL SHORTCOMINGS of the ASTM tentative method of test for brittleness temperature[1] have been brought out by recent papers (**1**, **2**, **5**),[2] especially concerning its usefulnes to determine reproducibly the brittleness temperature of polyethylene plastics. The variables discussed, among others, have been specimen conditioning and preparation of specimens. The use of notched specimens was also proposed. This note confirms some of the reported findings and also describes additional variables not hitherto considered.

In the conditioning of specimens, differences in annealing may account for substantial differences in brittleness temperature. A difference of 14 C has been noted between quenched and slowly cooled, but otherwise comparable specimens, as shown in Table I. The specimens were razor-cut from plaques compression-molded at 115 C. One plaque was rapidly cooled to room temperature by water immersion, while the other was cooled at a rate of 0.2 C per min. These findings agree well with data given by Hoff and Turner (**1**), but are less severe than those reported by Birks and Rudin (**5**), indicating that the full development of the crystalline and spherulitic structure of polyethylene results in a rise of its lower useful temperature limit.

TABLE I.—THE EFFECT OF ANNEALING ON BRITTLENESS TEMPERATURE OF POLYETHYLENE, MELT INDEX 0.4,[a] DENSITY 0.920.[b]

Cooling Rate from 115 to 20 C (approximate), deg Cent per min	Number of Specimens Tested	Brittleness Temp. (F_{50}), deg Cent
100..........	75	−81
100..........	60	−78
0.2..........	60	−64

[a] Method of Test for Measuring Flow Rates of Thermoplastics by Extrusion Plastometer (Tentative) (D 1238), 1958 Book of ASTM Standards, Part 9, p. 398.

[b] Method of Test for Measurement of Density of Plastics by the Density-Gradient Technique (Tentative) (D1505), 1958 Book of ASTM Standards, Part 9, p. 511.

A specimen thickness of 0.075 ± 0.010 in. is specified in the tentative ASTM method. Such a wide tolerance may result in brittleness temperature variations of 15 C, as shown by the data in Table II. A specimen thickness of 0.075 ± 0.005 in. would possibly result in better test reproducibility.

The clamping pressure applied to the specimens when mounted is not specified by ASTM. One series of tests in this laboratory resulted in unusually high brittleness temperatures; it was discovered that excessive clamping pressures had been used by an overzealous technician. The use of a torque wrench prevents excessive tightening of the cap screws of the specimen holder. Figure 1 shows the effect of the torque on the screw on the resulting probabilities of brittle failure of low-density polyethylene.

For approximation in calculating the resultant compressive load on the screw, the formula $W = PL/fd$ can be used (**3**), where PL = torque, in-lb; f = a torque coefficient depending on frictional conditions; W = compressive load exerted by one cap screw, lb; and d = screw diameter, in. (**3**). For the experiment in question, a five-specimen holder with two $\frac{1}{4}$-20 screws was used. The value of f has been estimated to be 0.4, using nonlubricated stainless-steel

[1] Tentative Method of Test for Brittleness Temperature of Plastics and Elastomers by Impact (D 746), 1958 Book of ASTM Standards, Part 9, p. 355.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

TABLE II.—THE EFFECT OF SPECIMEN THICKNESS ON BRITTLENESS TEMPERATURE OF POLYETHYLENE, MELT INDEX 0.4,[a] DENSITY 0.920.[b]

Cooling Rate from 115 to 20 C (approximate), deg Cent per min	Number of Specimens Tested	Specimen Thickness, in.	Brittleness Temp. (F_{50}), deg Cent
100	45	0.065 ± 0.002	−80
100	90	0.075 ± 0.002	−81
100	45	0.080 ± 0.002	−78
100	45	0.085 ± 0.001	−64

[a, b] See footnotes to Table I.

components. It is known that the compression loads calculated in this manner may be in error by ± 30 per cent and thus will have to be taken as estimates. It should be concluded that in this test method compressive pressures of less than 150 psi should be applied to polyethylene specimens for better reproducibility of brittleness temperatures.

On examination of Fig. 1 it appears that there are two separate assignable causes for the variation of brittle-failure probability with clamping pressure at a given test temperature. The break in the curve is located where the specimen under a compressive pressure of 300 psi is strained approximately 2 per cent. The polyethylene stress-strain diagram is not suitable for the calculation of a Young's modulus of elasticity, as there is no true "proportional limit" for a completely elastic deformation. In engineering practice for design with polyethylene, $1\frac{1}{2}$ to 4 per cent strain is selected as a conservative sustained strain limit to avoid premature brittle failures. Our data partially confirm the soundness of such practices.

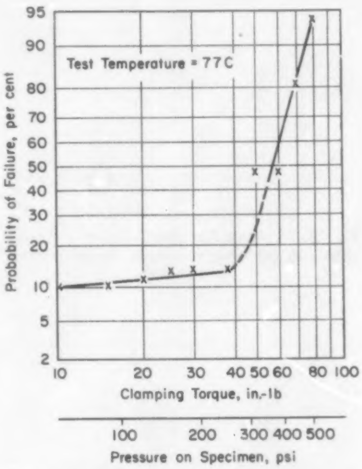

Fig. 1.—Effect of compression of specimens on probability of brittle failure.

It could be speculated that by loading a specimen over the above discussed "proportional limit," more or less permanent deformation occurs with some orientation of the molecular structure. This limits the segmental and uncoiling movements of the molecules. Such limitations would be expected to result in a decrease in entropy and in changes of primary and secondary transition temperatures (4). Such changes could be characterized by changes in brittleness temperature readings measured by test methods of the kind discussed here.

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Technical Note

Measuring the Roughness Factor of a Small Steel Disk

There has always been a need among users of flat rolled electrical steel for a rapid and accurate method of determining the lamination factor without the use of a large specimen such as the one described in ASTM Methods of Test for Electrical and Mechanical Properties of Magnetic Materials (A 344).[1] The effect of a low lamination factor is usually not felt until the lamination steel is made into a product such as rotating electrical machinery. Even then, some preventative action can result from measuring the lamination factor of the fabricated metal. However, after the steel is blanked and pierced into laminations it is not possible to obtain this value by using ASTM Method A 344, since there is usually not enough material available in the finished laminations for a specimen. Even if an Epstein specimen is sent along with a coil of steel, users find that a test for lamination factor is an expensive and time-consuming proposition. This paper presents data collected in measuring the roughness factor of a small steel disk.

[1] 1958 Book of ASTM Standards, Part 3, p. 406. Paragraph 19 of Methods A 344 reads as follows: "This test measures under pressure the lamination factor of a laminated structure composed of strips cut from magnetic material. The ratio of the volume calculated from the weight and density of the strips to the measured solid volume of the structure under pressure indicates the deficiency of effective steel volume. This is due to presence of oxides, roughness, insulating coatings, and other conditions affecting the surface of the strips."

Theory

The theory used in measuring the roughness factor of a small steel disk is as follows:

The roughness factor (note that use of this term denotes a difference between roughness factor and lamination factor) of a lamination is defined as the actual volume of metal multiplied by 100 and divided by the calculated volume.

$$R = \frac{V_a}{V_c} \times 100$$

The roughness factor for a disk is then,

$$R = \frac{W_{\text{air}} - W_{\text{water}}}{(\pi D^2/4)T} \times 100$$

where:

W_{air} = the weight of the disk in air, g
W_{water} = the weight of the disk in water, g
D = diameter of the disk, in., and
T = thickness of the disk, in.

If W_{air} and W_{water} are measured in grams; D and T are measured in inches and D equals 0.881 in.

Then:

$$R = 10\,\frac{W_{air} - W_{water}}{T}$$

This value can be used per se to describe the stacking characteristics of the sheet. It is related, however, to the ASTM lamination factor value. The relationship developed by the collected data conforms to the following equation:

$$\text{Lamination factor} = (0.769R + 22.8) \pm 1.32$$

This last equation represents the correlation between roughness factor and lamination factor when both are determined on the same specimens having a statistically significant population. Figure 1 shows this relationship. The data were treated by the least squares method.

Specimen Preparation

The disk is blanked from the steel specimen using a sharp punch and die set. It is important that the disk be flat and have a clean edge. The disk is wiped with a clean cloth before any measurements.

Testing Procedure

The thickness of the disk is measured with a vernier micrometer to fourth-place accuracy.

The disk is then weighed both in air and in water on an analytical balance to five significant figures. One or two drops of a wetting agent is added to the water to deter any buoyancy effects. The roughness factor is then calculated. For reference purposes the roughness factor may be converted to a lamination factor value by use of the curve in Fig. 1.

Testing Results

The data used in Fig. 1 were obtained by determining both roughness factor and ASTM lamination factor of 51 different coils of flat rolled electrical steel. Hundreds of other determinations have apparently been made successfully, that is, a supplier of lamination steel has very closely duplicated our results. We suggest circulation of ten roughness factor specimens among any steel suppliers or users who wish to participate in evaluating the validity of this proposed short and economical test for future use in the control of the very important variable of physical surface character in electrical sheet steel.

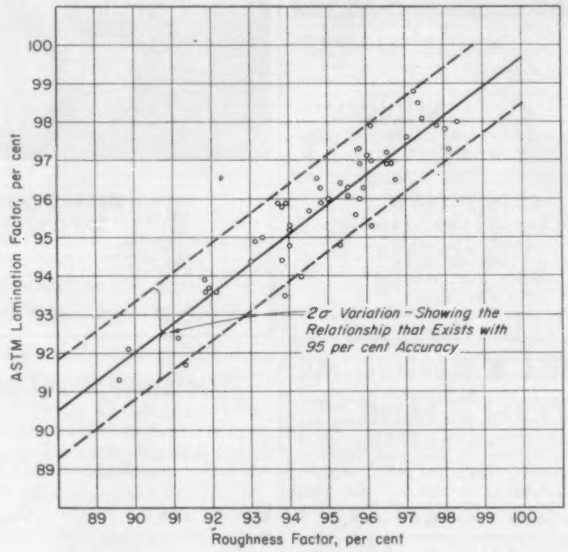

Fig. 1.—Roughness factor *versus* ASTM lamination factor.

Discussion

This method requires no assumed density of the material. This is especially advantageous when measuring the lamination factor of silicon grades of flat rolled electrical steel, since the density varies considerably within each grade.

The damping effect of the disk in water when the disk is weighed in water is of such magnitude that it is not possible to achieve balance by counting the number of swings of the indicator on the analytical balance. Balance is achieved by noting which direction the indicator moved from the position indicating absolute balance and then adjustments are made to achieve that balance.

This method bridges the gap between describing the material as having a "Pangborn" or matte finish and measuring its lamination factor. The roughness factor method also provides a more rapid means of controlling the surface finish than the ASTM method. After approximately one year of testing, this method has helped to bring about a significant reduction in the variation in lamination factor.

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Copies of these books are not available through ASTM; all inquiries concerning them should be addressed to the publisher.

Direct Conversion of Heat to Electricity

Edited by J. Kaye and J. A. Welsh; John Wiley & Sons, Inc., 1960; 373 pp.; $8.75.

Reviewed by R. N. King, Jr., Industrial Components Div., Raytheon Co.

THIS VOLUME consists of a collection of papers, most of which were presented at a special summer program given at the Massachusetts Institute of Technology in 1959, on "Direct Conversion of Heat to Electricity." These papers have been prepared by prominent workers in this new field, both from industry and the universities. The editors, both of MIT, are members of the staff of the Mechanical Engineering Department.

To produce electricity directly from various energy sources, with reasonable efficiencies, has long been the desire of scientists and engineers. Owing, perhaps, to current pressing needs and also to technological advances in other fields, practical methods have now been postulated and tested, making these desires a reality. No single concentrated collection of references and information existed on this general subject before publication of this volume. Because of its scope and of the individual merit of each paper, this book should be of value to anyone interested in this field.

The book contains fundamental considerations on thermionic conversion (both vacuum and gas-filled devices), thermoelectric conversion (thermocouples), magnetohydrodynamic conversion (conversion by the separation of positive and negative charges in an ionized gas), and fuel cells (separation of opposite charges as a result of chemical reactions). Copious references are listed after each paper.

The various papers on thermionic conversion treat the subject from the standpoint of the thermodynamics, the physics of thermionic emission, and the optimization of design. The main limitation on the vacuum diode, the space charge barrier, is indicated. Methods by which this may be overcome, embodied in the magnetic triode and the gas-filled diode, are treated. A complete section is devoted to the gas-filled diode.

The section on thermoelectric conversion is prefaced by a paper which summarizes thermoelectric effects in a helpful manner. The thermodynamics, materials considerations (of which much of the study in this field is concerned), optimization of design, and consideration of thermoelectric cooling are discussed.

Two papers on magnetohydrodynamic converters provide fundamental information on the physics and thermodynamics of such devices. A state-of-the-art summary of fuel cells as energy converters is given in one paper. By far the most extensive treatment is given to thermoelectric and thermionic converters.

(*Continued on page 64*)

BOOKSHELF

(*Continued from page 62*)

The presentation is at the graduate level. While this volume is not a text, it nevertheless provides a presentation of each subject in a logical manner and should be found informative by a reader possessing a background in the physical sciences. The emphasis is on both theoretical and experimental aspects rather than on engineering problems associated with practical device fabrication. Considerations presented should nevertheless be of value to a reader engaged in device work.

The Chemical Elements

Helen Miles Davis; Science Service-Ballantine Books, New York (1959); 198 pp.; 50 cents.

Reviewed by S. F. Etris, ASTM Staff.

THIS PAPER-COVER book begins with a straightforward explanation of the elements and their subatomic particles, the periodicity of the atomic structure, and the resulting periodicity of the atomic properties. The student will find this section of value.

The book then presents the published reports, written by the discoverers, of the first identification of the verified chemical elements, many of which are particularly interesting. Unfortunately, the layman is left somewhat unsatisfied, since there is no evaluation of the reports as to their accuracy or value in the light of present knowledge. How close did they reach the mark?

A tabulation of unconfirmed elements is also given with their champions, and only a word of final decision as to why they were stricken from the lists.

A helpful list of the elements, their uses, and the atomic weights of their isotopes is appended.

Air Weapons Materials Application Handbook — Metals and Alloys (ARDC TR 59-66).

G. Sachs, editor-in-chief; Air Research and Development Command, USAF (Dec. 1959); 553 pp.

Adapted from publisher's description.

THIS FIRST edition of a new handbook assembles information on the properties of alloys used in air weapons, particularly alloys developed and used during the past decade. Part I discusses the properties that are presented in Part II for each alloy, in turn. Physical and chemical properties given include: melting range, phase changes, thermal conduction, thermal expansion, specific heat, density, electrical and magnetic properties, corrosion and oxidation resistance, and nuclear properties. Mechanical properties include: elastic properties, notched and smooth tensile properties at various temperatures, creep and creep rupture strengths, and fatigue properties. Some information is also given on such fabrication procedures as forming and casting, machining, welding, heat treating, and surface treating. Information is given in the same order for each alloy, in tables or curves, as appropriate.

The handbook was prepared by the Syracuse University Research Institute with the assistance of a number of cooperating companies. Information was obtained principally from producers' data sheets and from the Technical Reports of the Wright Air Development Division. Various ASTM publications, as well as several aircraft, engine, and component producers, were also drawn upon.

Statistical Design

W. J. Youden; ACS Applied Publications, Washington, D. C., 1960; 72 pp.; $2.

THE BIMONTHLY articles on statistical design written by Dr. Youden during his six years (1954–1959) as contributing editor for *Industrial & Engineering Chemistry* are now available in this reprint booklet. Dr. Youden is a statistician with the National Bureau of Standards.

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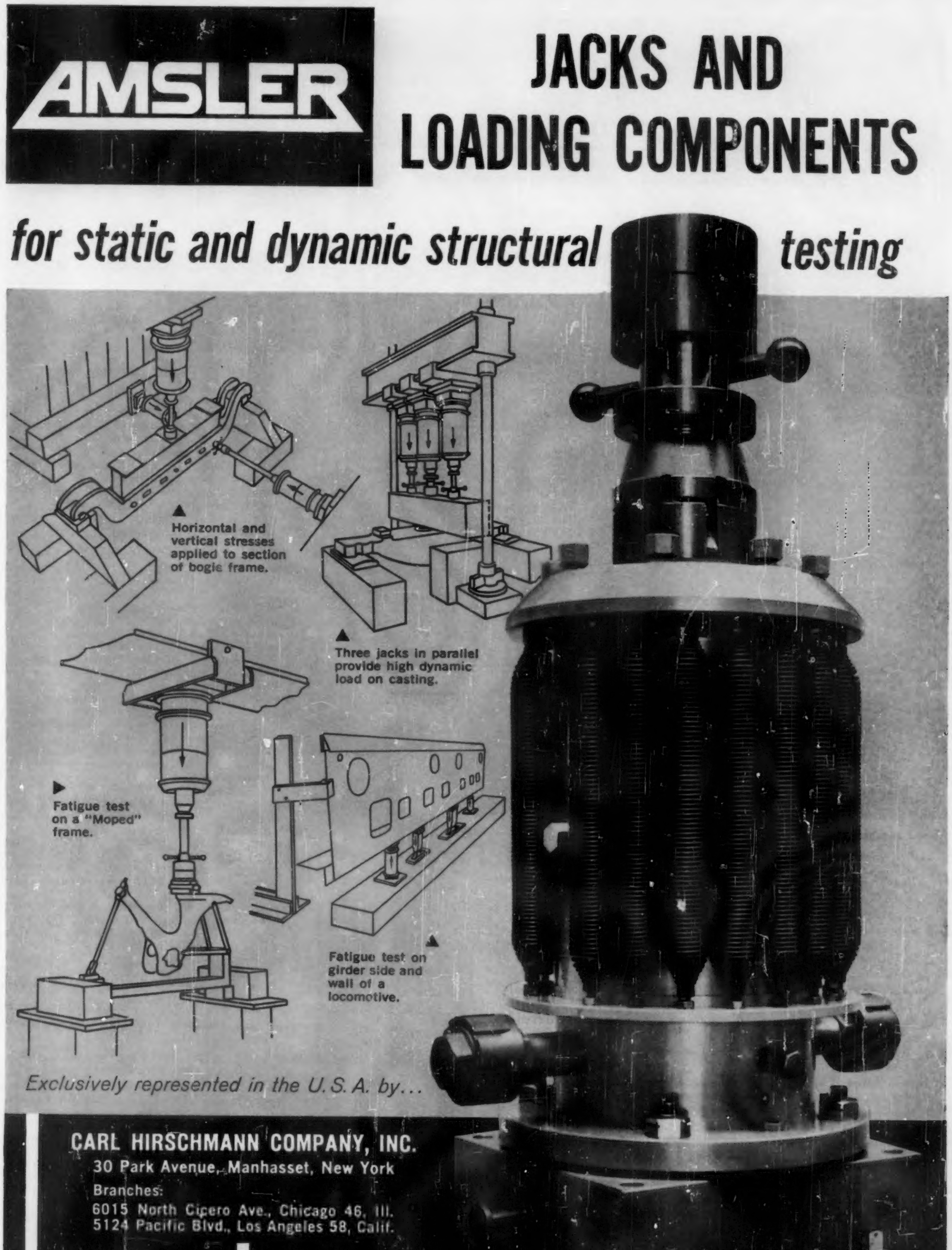
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(*Continued on page 68*)

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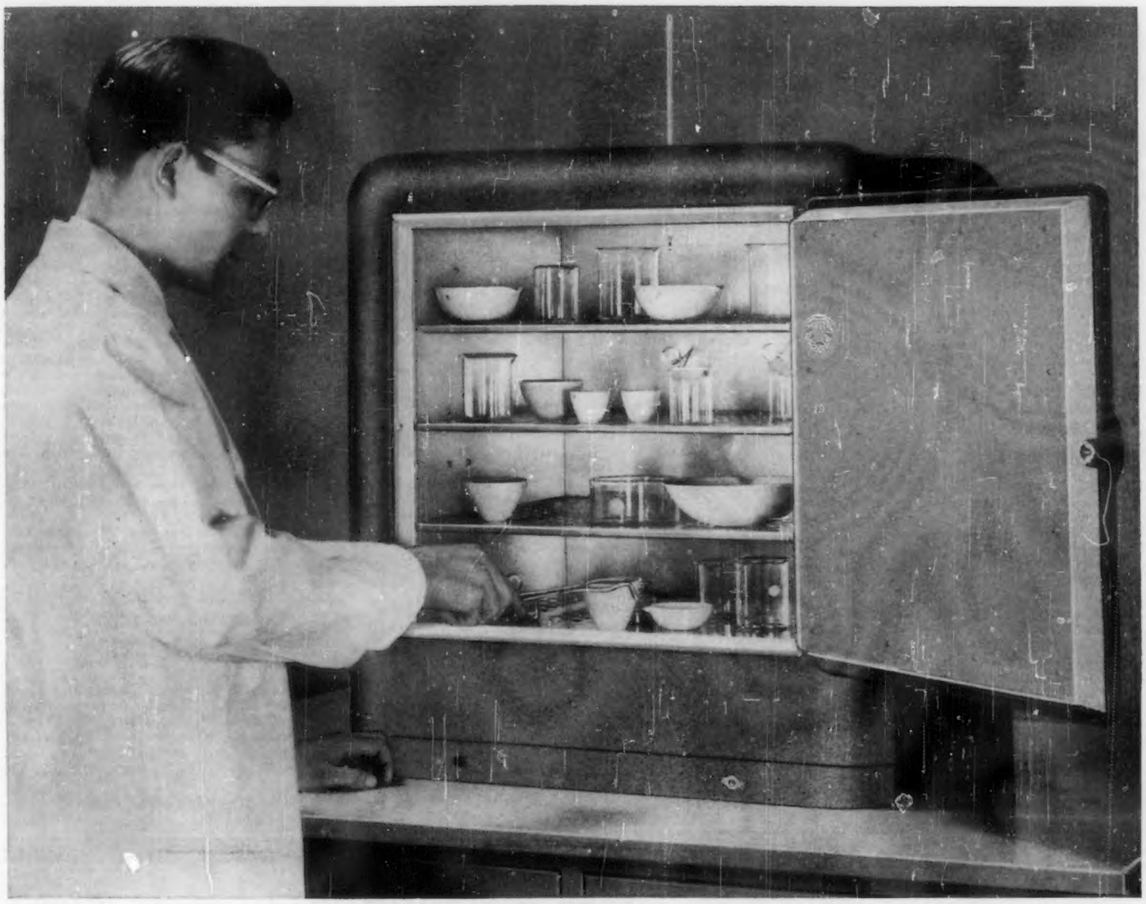

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Other Than U. S. Possessions

Aeropreen Products, Ltd., R. D. Millar, managing director, Lindsay Ave., High Wycombe, Bucks, England.

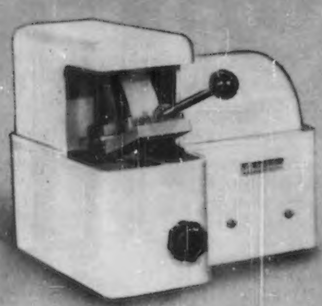
Cristalerias de Chile, S. A. Pedro J. Jaramillo, chief engineer, Casilla 162-D, Santiago, Chile.

Daihan Printing Ink Manufacturing Co., Ltd., Chung D. Han, president, Box 34, Central Seoul, Seoul, Korea.

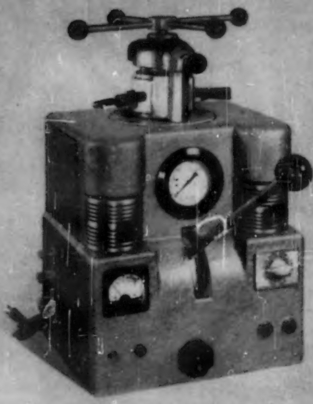
Valvulas Industriales, S. A., Xavier Etchegaray, sales manager, Insurgentes Sur 92A, Mexico 4, D. F., Mexico.

Aramburo, Luis Enrique, ingeniero civil e industrial, Universidad del Cauca, Popayan-Cauca, Colombia. For mail: Carrera 2a. 2-61, Popayan-Cauca, Colombia. [A]

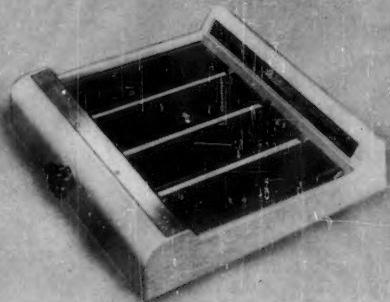
(*Continued on page 73*)



1114 AB Cutter



1330 AB Speed Press



1470 AB Handimet Grinder

Everything for METALLOGRAPHY

1500 AB Standard Polisher

1114 AB Cutter — The ideal wet abrasive cut-off machine for laboratory work on stock up to ½″. It is specially designed for the metallurgist for precision, speed and economy.

1330 AB Speed Press — Rapid production of perfectly mounted samples, achieved only with the unique preheated premolds, removes another laboratory bottleneck.

1470 AB Handimet Grinder — Four stages of fine grinding are accomplished with speed and facility on the Handimet. It makes the most of modern grinding methods.

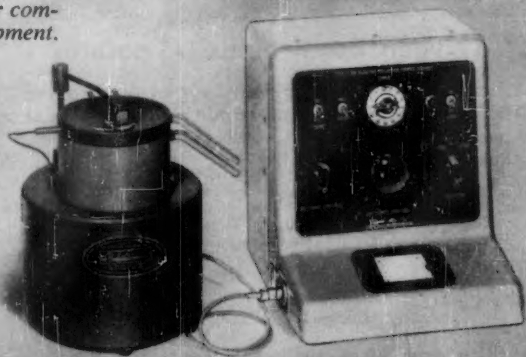
1905-2 AB Automet Attachment

1500 AB Standard Polisher — This is the most popular metallographic polisher ever built. It has direct 2 speed drive, accurate balance, quick change wheels and is easy to clean.

1905-2 AB Automet Attachment — High quality microsections are produced by this unit with great savings of time to the operator. Fits all Buehler Low Speed Polishers.

1720 AB Electro-Polisher — With this unit, electro polishing becomes routine. Design and materials are selected for simplicity of operation and minimum maintenance.

The above are a few of the popular models from our complete line of metallographic sample preparation equipment. Many other models and types are available for your selection. Buehler equipment is designed and built according to suggestions from prominent metallurgists in America and throughout the world and is backed by 25 years of service to your industry.



1720 AB Electro-Polisher

Buehler Ltd.

METALLURGICAL APPARATUS

2120 GREENWOOD ST. EVANSTON, ILLINOIS, U. S. A.

FOR FURTHER INFORMATION CIRCLE 723 ON READER SERVICE CARD

NEW MEMBERS

(*Continued from page 70*)

Bengtsson, C. E., chief product engineer, International Harvester Maquinas, S. A., C.P. 1881, São Paulo, Brazil.

Brognon, Georges Philippe, general manager, Companhia Petroleos Angola, C. P. 1320, Luanda, Angola, Africa. For mail: C. P. 1627, Luanda, Angola, Africa.

Bult, John Alan, Electrolytic Zinc Company of Australia, Ltd., Box 856K, Melbourne, Victoria, Australia.

Colombo, Ezio, manager, Testing Dept., Soc. Montecatini, Ferrara, Idrocarburi, Italy.

Cuba, Departamento de Normas, Ministerio de Comercio de la Republica de Cuba, Monte y Factoria, Havana, Cuba.

Ferrer F., Diego, hydraulic engineer, Gimsa S. A., Av. Anauco 8, Sn. Bernardino, Caracas, Venezuela. For mail: Av. Berlin, Qta. Trampolin La California-Petare, Miranda, Venezuela.

Foerster, Friedrich, doctor of philosophy, Institut Dr. Foerster, Grathwohlstrasse 4, Reutlingen, West Germany.

Laboratorio de la Direccion de Vialidad del Ministerio Obras Publicas, Rupanco 202 La Florida, Santiago, Chile.

Mosgard-Jensen, J., engineer, A/S Atlas, Lundtoftevej 160, Lyngby, Denmark.

Rahman, Khalil-ur-, head, Department of Quality Control, Bawany Violin Textile Mills, Ltd., 2nd Fl. Bank House, Habib Square, Bunder Rd., Karachi, Pakistan. [A]

Russell, W. D., supervisor, diode development, Dept. 8221, Northern Electric Co., Ltd., 1261 Shearer St., Montreal 22, P. Q., Canada.

Shivalingappa, Bangalore K., assistant engineer, Government of Mysore, India, Public Works Dept., Mysore State, Bangalore, India. For mail: c/o B. D. Kalappa, Sajjan St., Koratagere P. O., Tumkur District, Mysore State, India.

Surdi, Domenico, resident engineer, S.-A.U.T.I. Co., Box 10, Ahwaz, Iran.

Urad pro Normalizaci (Office for Standardization), Miroslav Baudys, engineer, Vaclavske nam. 19, Prague 3, Czechoslovakia.

BOOKSHELF

(*Continued from page 64*)

Bibliography on "Evaluation of Strength Tests of Concrete"

American Concrete Inst.; 8½ by 11 in., saddle-stitched and punched for three-ring binder; $2.00.

Adapted from publisher's description.

This new bibliography lists and annotates selected articles appearing in available technical publications issued from 1924 to 1958 and dealing specifically with compression tests of concrete, variations in test results, and evaluation of tests.

The bibliography was compiled as part of the work of ACI Committee 214, Evaluation of Results of Strength Tests of Concrete. In announcing the bibliography, the committee noted that the value of statistical methods in evaluating test results has long been recognized, and that application of statistical methods to the control of concrete quality is long overdue.

ACI Bibliography No. 1, the first in this ACI series, lists publications and articles on prestressed concrete.

(*Continued on page 90*)

NEWS OF MEMBERS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

Among the new officers of the American Road Builders Association's Engineering Division are **George S. Richardson,** partner in the Pittsburgh, Pa., consulting firm of George S. Richardson & Associates, who was elected president, and **J. Stephen Watkins,** consulting engineer of Lexington, Ky., who was elected vice-president.

The U S Department of Commerce presented silver medals to **Bernard G. Achhammer,** assistant chief, Plastics Section, National Bureau of Standards, for "his outstanding contributions to the science of plastics polymers, in particular chemical structure and stability relationships, and for meritorious authorship," and **James M. Cassell,** chemist with the Leather Section of NBS for "his valuable contribution to the chemistry and structure of collagen and for meritorious authorship."

John R. Abner, formerly research engineer, Monsanto Chemical Co., Dayton, Ohio, is now chemical engineer, The Chemstrand Corp., Pensacola, Fla.

C. Howard Adams, manager of plastic development, Monsanto Chemical Co., St. Louis, Mo., has returned to the Plastics Div., Springfield, Mass., as senior engineering supervisor in product engineering.

William J. Altier, prior to becoming associated with McCoy Electronics Co., Mt. Holly Springs, Pa., as senior engineer, was assistant manager, Reeves-Hoffman Div., Carlisle, Pa.

William D. Appel received an honorary Doctor of Science degree from North Carolina State College on May 29. A past-chairman of Committee D-13 on Textile Materials, Dr. Appel was cited as a "textile colorist and technologist of the first rank." His sponsor during the presentation ceremony was **B. L. Whittier,** present chairman of Committee D-13.

Arnold O. Beckman, president, Beckman Instruments, Inc., Fullerton, Calif., received an Illini Achievement Award for "leadership in the field of precision instruments" in ceremonies at the University of Illinois.

Leonard W. Bell, until recently office engineer, Portland Cement Assn., Lansing, Mich., is now assistant to architects representative, Eero Saarinen and Associates, Birmingham, Mich.

Leonard M. Bennetch is now with C. K. Williams and Co., Easton, Pa. Formerly he was research director, Reichard-Coulston, Inc., Bethlehem, Pa.

Donald A. Bierstock is now a construction engineer with S. Bierstock and Sons, Kitchener, Ont., Canada. Formerly he was a sales engineer for Master Builders Co., Ltd., Winnipeg, Ont., Canada.

Joseph Brown, previously sales manager, The Tupman Thurlow Co., Inc., New York, N. Y., is associated with New York Sancor Corp., New York, N. Y., in the same capacity.

Richard H. Carter has resigned his position as standards engineer, Engineering Standards Service, General Electric Co., Schenectady, N. Y., and has opened Carters' Hobbycrafts Shop in Costa Mesa, Calif.

Nicholas Chryssafopoulos, formerly chief engineer, Woodward-Clyde-Sherard and Associates, Montclair, N. J., is the new resident manager of the Kansas City and St. Louis offices of the same firm.

In June commencement exercises at Drexel Institute of Technology, **Miles N. Clair** received the honorary degree of Doctor of Engineering. Senior vice-president of ASTM, Dr. Clair is president of The Thompson & Lichtner Co., a consulting and management engineering firm of Brookline, Mass.

R. J. Costanzo, previously supervisor, Research and Development Laboratory, Harvey Hubbell, Inc., Bridgeport, Conn., is now supervisor, research, Electric Research Laboratory, Inc., Roxbury, Conn.

Brinton Coxe is now with the Mobil Oil Co. of Canada, Libyan Branch, Tripoli, Libya. He had been petroleum engineer, Socony-Mobil Oil Co. of Venezuela, Caracas, Venezuela.

Vaughn M. Daggett, chief engineer, Maine State Highway Commission, Augusta, Me., has been appointed to the Planning and Design Policies Committee of the American Association of State Highway Officials.

James Burt Davis, formerly consulting engineer, United States Testing Co., Inc., Tulsa, Okla., is now a consulting engineer in Tulsa.

Robert B. Diemer, general manager and chief engineer, The Metropolitan Water District of Southern California, Los Angeles, Calif., is one of four recipients of the 1960 Missouri Honor Awards for Distinguished Service in Engineering presented by the University of Missouri. The citation recognized Mr. Diemer for "his outstanding achievement in the development of irrigation in the United States and Mexico" and for "his engineering skill and foresight in directing the location, design, and construction of the Colorado River Aquduct."

Lonnie E. Dye, formerly an engineer with Fulton & Cramer, Lincoln, Nebr., is now a public health engineer, State of Nebraska, Dept. of Health, Lincoln, Nebr.

(Continued on page 76)

NEWS OF MEMBERS

(*Continued from page 74*)

Francis T. Eddy is assistant to the president, Telautograph Corp., Los Angeles, Calif. Previously he was vice-president, Bayside Industries, Inc., Costa Mesa, Calif.

Richard C. Elstner is with The Engineers Collaborative, Des Plaines, Ill. He had been structural development engineer, Portland Cement Assn., Chicago, Ill.

Alfred F. Felgendreger is service to sales supervisor, Keasbey-Mattison Co., Ambler, Pa. Previously he was chief chemist, Continental Mills, Inc., Philadelphia, Pa.

Davis S. Fields, Jr., is now assistant professor of metallurgy, University of Kentucky, Lexington, Ky. He had been research metallurgist, Alco Research Laboratories, Aluminum Company of America, New Kensington, Pa.

James E. Flood has been promoted from technical director to vice-president and technical director, Plastic Wire and Cable Corp., Jewett City, Conn.

Andrew G. Forrest, assistant to the chief metallurgist, Republic Steel Corp., Cleveland, Ohio, has been named assistant chief metallurgist.

Rudolph Frizzi, formerly spectrographer, New Jersey Metals Co., Elizabeth, N. J., is now serving Alpha Metals, Inc., Jersey City, N. J., in a similar capacity.

Carlton S. Front is now an engineer with Hendry Corp., Tampa, Fla. He was president, Gulf Coast Testing Laboratory, Inc., Pinellas Park, Fla.

George J. Fuld, formerly instructor in biochemical engineering, Massachusetts Institute of Technology, Cambridge, Mass., is a chemist, Fuld Brothers, Inc., Baltimore, Md.

E. E. Gardiner, research coordinator, California Research Corp., San Francisco, Calif., has been appointed senior research coordinator, Petroleum Products Dept.

Melvin E. Getz, formerly chemist, U S Bureau of Mines, College Park, Md., is now chemist, Food and Drug Administration, U S Dept. of Agriculture, Washington, D. C.

Ray C. Giddings is a consulting engineer in Pasadena, Calif. Formerly he was materials engineer, Honolulu Construction and Draying Co., Ltd., Honolulu, Hawaii.

Frederick P. Glazier, formerly vice-president, Laboratory Equipment Corp., Mooresville, Ind., has joined Sun Oil Co., Philadelphia, Pa., as special assistant in the Research and Development Div.

A. T. Goldbeck, engineering consultant, National Crushed Stone Assn., Washington, D. C., retired August 1, 1960. Dr. Goldbeck is an Honorary Member of the Society, a 50-year member and past director. During the years he has been active on many committees, particularly Committees C-9 on Concrete and Concrete Aggregates and D-4 on Road and Paving Materials, which committees elected him to Honorary Membership. Dr. Goldbeck will continue his membership in the Society and will reside at 7105 Beechwood Drive, Chevy Chase 15, Md.

Edward E. Hall has been promoted to the position of assistant general sales manager, Universal-Cyclops Steel Corp., Bridgeville, Pa. Mr. Hall was manager of technical services prior to his recent appointment.

John J. Hazel, chief ceramic engineer, Republic Steel Corp., Cleveland, Ohio, has been appointed assistant director of research at Republic's Research Center, Cleveland, Ohio.

Winford B. Hickman, prior to becoming chief engineer, Clark Equipment Co., Michigan City, Ind., was chief research and development engineer, Dorsey Trailers, Elba, Ala.

George W. Ingle has been named assistant research director of a newly formed section on polymer properties and standards, Monsanto Chemical Co., Springfield, Mass.

(*Continued on next page*)

NEWS OF MEMBERS

Clyde B. Jenni, chief metallurgist, General Steel Castings Corp., Eddystone, Pa., has been selected by the Steel Founders' Society of America to deliver the SFSA exchange lecture before the British Steel Castings Research Assn. in Harrogate, England, this fall. He will deliver his paper on "Technical Control in Steel Foundries in North America." Earlier this year Mr. Jenni received the SFSA Technical and Operating Medal for his outstanding contributions to the steel castings industry.

Arthur E. Juve, director of technical services, The B. F. Goodrich Company's Research Center, Brecksville, Ohio, has contributed an article on rubber products manufacture to a forthcoming 15-volume Encyclopedia of Science and Technology. The encyclopedia, to be published by McGraw-Hill this fall, will be the largest work of its kind ever produced. Mr. Juve's article describes the more common methods of manufacture adaptable to the widest variety of rubber products.

Antoine Kawam, formerly technical director, The Englander Co., Inc., Baltimore, Md., is now chemist, Union Carbide Corp., Tarrytown, N. Y.

Vincent G. Kling, architect, Philadelphia, Pa., has been given one of the architectural profession's highest honors—membership in the College of Fellows of the American Institute of Architects—for his notable contributions to design.

William B. Kouwenhoven, professor of electrical engineering and dean, School of Engineering, Johns Hopkins Univ., Baltimore, Md., who also lectures on surgery at the university, has devised, with three colleagues, a method of closed-chest massage for a stopped heart. The team experimented first with animals, then adapted the idea to humans. Johns Hopkins researchers have reported success in 50 cases with this method. It is now standard practice in the Johns Hopkins emergency room.

A. Umit Kutsay, until recently assistant chief engineer, Baldwin-Lima-Hamilton Corp., Waltham, Mass., is now vice-president, Strainsert Co., Bridgeport, Pa.

Robert A. Lange is plant metallurgist, Braeburn Alloy Steel Corp., Braeburn, Pa. Previously he was an engineer with Westinghouse Electric Corp., Pittsburgh, Pa.

W. T. Lankford, Jr. has been named chief, Sheet Products Div., United States Steel Corp., Monroeville, Pa.

Don Albert Linger, previously instructor of civil engineering, Iowa State College, Ames, Iowa, is now associate professor, Department of Civil Engineering, New Mexico State Univ., University Park, N. Mex.

W. F. MacKenzie, chief chemist, Whitehall Cement Manufacturing Co., Cementon, Pa., retired recently. For many years, Mr. MacKenzie represented Whitehall's sustaining membership in the Society and on Committee C-1 on Cement.

Thomas J. McLeer was named assistant to the vice-president, Vanadium Corporation of America, New York, N. Y. Dr. McLeer was director of research and development, Cooper Alloy Corp., Hillside, N. J.

Neal B. Mitchell, Jr., is assistant professor, Cornell Univ., Ithaca, N. Y. He was an instructor at Tufts Univ., Medford, Mass.

John T. Moriarty, previously technical representative, H. K. Porter Co., Inc., Thermoid Div., Pittsburg, Calif., is technical director, Master Processing Corp., Lynwood, Calif.

The many friends and associates of **James G. Morrow,** ASTM past-president and Honorary Member, and long time metallurgical engineer, The Steel Company of Canada, Ltd., were delighted to have him with us for a few days at the Annual Meeting. Mr. Morrow has made a splendid recovery from a major operation months ago, and although he has retired from his duties at The Steel Company of

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NEWS OF MEMBERS

(Continued from page 77)

Canada, he is maintaining his contacts with a number of industrial and governmental committees. Mr. and Mrs. Morrow are living at their farm near Jarvis, Ont., south of Hamilton, and close to Lake Erie. The address is R. R. 3, Port Dover, Ont., Canada.

Glenn Murphy has been named head of the newly formed Department of Nuclear Engineering at Iowa State Univ. Dr. Murphy is also head of the Department of Theoretical and Applied Mechanics.

Gordon S. Mustin is senior staff engineer, Reed Research, Inc., Washington, D. C. He had been packaging research coordinator, Douglas Aircraft Co., Inc., Santa Monica Div., Santa Monica, Calif.

Arthur Nolan is general sales manager, International Latex Corp., Dover, Del. Formerly he was vice-president and general manager, Latex and Rubber, Inc., Baltimore, Md.

Roydon S. Pratt, chief plant metallurgist, Bridgeport Brass Co., Bridgeport, Conn., has been named technical and research director.

S. J. Richter, previously project engineer, Leland Electric Canada, Ltd., Guelph, Ont., Canada, is now with Coca Cola, Ltd., Toronto, Ont., Canada, in the same capacity.

Harry G. Romig is now associated with Operations Research, Inc., Los Angeles, Calif. Formerly he was quality director, International Telemeter Corp., Los Angeles, Calif.

Henry G. Seller, formerly assistant research director, ORRadio Industries, Inc., Opelika, Ala., is now associated with Newport Industries Co., Pensacola, Fla.

Edwyn L. Shoemaker, Jr., is now affiliated with Camden Lime Co., Camden, N. J., in concrete quality control. He had been with Atlantic Prestressed Concrete Co., Trenton, N. J., in quality control.

John C. Sprague joined the research staff, Lock Joint Pipe Co., Wharton, N. J., as head of its concrete section.

Robert L. Stanley, executive secretary, Diesel Engine Manufacturers Assn., Washington, D. C., is secretary of the U S National Committee of International Congress of Combustion Engines. This committee is sponsored by the Oil and Gas Power Div. and the Gas Turbine Power Div. of The American Society of Mechanical Engineers.

A. R. Stark, senior research chemist, Humble Oil and Refining Co., Baytown, Tex., has been elected councilor of the Chemical Div., American Society for Quality Control.

Harold W. Stiegler, American Association of Textile Chemists and Colorists, Lowell Technological Inst., Lowell, Mass., retired after 14 years of service. Dr. Stiegler represented AATCC in Society membership.

William C. Stone, prior to becoming chief civil engineer, Ferguson Engineers, Inc., Mesa, Ariz., was county engineer, Boone County, Boone, Iowa.

Gerold H. Tenney, group leader, Los Alamos Scientific Laboratory, Los Alamos, N. Mex., was awarded the Scroll of Appreciation and Gold Medal of the Third International Conference on Nondestructive Testing held in Tokyo in March for his contribution to the advancement of research and the furtherance of international cooperation in the field of nondestructive testing.

R. D. Thomas, Jr., has been elected president of the American Welding Society. He is president of the Arcos Corp., Philadelphia, Pa.

William B. Wallis, consulting engineer, Strategic Materials Corp., New York, N. Y., and Ernest W. Weaver, retired engineering executive, Surface Combustion Co., Toledo, Ohio, have been given the Trinks Award, the highest honor in the industrial heating equipment industry. It is sponsored by *Industrial Heating* for outstanding contributions. Mr. Wallis was cited for his inventions and engineering achievements in the field of the electric arc melting furnace.

J. Raymond Watson, formerly instructor, University of Puerto Rico, College of Agriculture and Mechanic Arts, Mayaguez, Puerto Rico, is now chief engineer, Prescon Caribe, Inc., San Juan, Puerto Rico.

Richard E. Wening is administrative assistant, The Harshaw Chemical Co., Cleveland, Ohio. He had been associate editor, *Rubber World*, New York, N. Y.

W. B. Willsey has been appointed assistant chief chemist, Philadelphia Electric Co., Philadelphia, Pa.

John R. Wilson has been appointed associate engineer on the joint engineering staff of the National Sand and Gravel Assn. and the National Ready Mixed Concrete Assn., Washington, D. C.

Calvin S. Yoran, formerly technical director, Dryden Rubber Div., Sheller Manufacturing Corp., Keokuk, Iowa, is vice-president, American Rubber and Plastics Corp., LaPorte, Ind.

A. C. Zettlemoyer, research director, National Printing Ink Research Inst., and professor of chemistry, Lehigh Univ., Bethlehem, Pa., received the 7th Annual Ault Award of the National Association of Printing Ink Makers for his outstanding contributions to the printing ink industry.

DEATHS...

Dudley K. French, consulting chemist and engineer, Winnetka, Ill. (June 10, 1960). Mr. French joined the Society in 1913 and from 1916 to 1932 was active in the work of Committee D-2 on Petroleum Products and Lubricants. When Committee D-19 on Industrial Water was formed in 1932, Mr. French was one of the charter members, and was active in that committee's work until the time of his death.

Albert Haertlein, professor of civil engineering, Graduate School of Engineering, Harvard Univ., Cambridge, Mass. (June 7, 1960). Dr. Haertlein joined ASTM in 1921 and was a member of the New England District Council from 1954 to 1958.

C. E. Harness, city engineer, City and County of Denver, Denver, Colo. (April 17, 1960). Mr. Harness joined the Society in 1959.

Harry Hey, managing director, Electrolytic Zinc Company of Australasia, Ltd., Melbourne, Australia (April 11, 1960). Mr. Hey joined ASTM in 1949.

A. L. Kuehn, New York, N. Y. (May 23, 1960). Mr. Kuehn was a member of the Society for over 40 years, and served on Committee D-7 on Wood.

Sergi Leoni, naval mechanical engineer, Industrie Italiane del Petrollio, Mantova, Italy (not recently). Mr. Leoni had been a member of the Society since 1957.

H. R. Nelson, Battelle Memorial Inst., Columbus, Ohio (recently). Mr. Nelson represented the institute on Committee C-20 on Acoustical Materials since 1949.

A. G. Sturrock, manager, Metallurgical Div., Wyckoff Steel Co., Chicago, Ill. (July 1, 1960). Mr. Sturrock represented his company in Society membership and on Committee A-1 on Steel.

OTS Research Reports

THESE REPORTS, recently made available to the public, can be obtained from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Order by number.

Materials Research in the Navy, PB 161470, \$6. PB 161471, \$5.
Composite Materials and Composite Structures (Proceedings of the Sixth Sagamore Ordnance Materials Research Conference), PB 161443, \$7.
Sixth Materials Review, PB 161463, \$2.25.
Notes on Mechanical Testing Techniques at Very Low Temperatures, PB 161193, 50 cents.
Adaptation of Ceramic Tube Types, PB 151922, \$3.
Metal Fiber Reinforced Ceramics, PB 161481, \$1.25.
Influence of Surface on Ceramic Mechanical Properties, PB 161309, \$1.
Economic Analysis for Turning with Ceramic Tools, PB 161466, \$1.75.
Ceramics Studies Summary Technical Report, PB 161146, 50 cents.
Magnetic Properties of Some Ferrite Micropowders, PB 161533, 50 cents.
Dynamic Measurements of the Magnetoelastic Properties of Ferrites, PB 151408, \$1.
Synthesis and Purification of Dielectric Materials, PB 161366, \$2.75.
Research on Field Emission Cathodes, PB 161526, \$2.75.
Organic Semiconductors, PB 161459, \$1.25.
A Survey of Solid-State Light Amplifiers and Allied Devices, PB 161465, \$1.75.
Methods of Purification of Metals and Intermetallic Compounds, PB 161415, \$2.25.
Preparation of High Purity W, Mo, Ta, Cb, and Zr, PB 161365, 50 cents.
Study of Ultra-High Temperatures, PB 161460, \$1.
Organo-Metallic and Organo-Metalloidal High-Temperature Lubricants and Related Materials, PB 131176, \$1.75.
High-Temperature Evaluation Procedures for Lubricants, PB 161506, 75 cents.
Perarylated Silanes. Identification by X-Ray Diffraction Powder Patterns, PB 161312, \$1.
Fluoroalkoxysilanes, PB 161026, 50 cents.
High-Temperature Corrosion Study Interim Report for the Period November, 1958, through May, 1959, July, 1959, \$1.25.

(*Continued on page 89*)

NEWS NOTES ON

Laboratory Supplies and Testing Equipment

Note. This information is based on literature and statements from apparatus manufacturers and laboratory supply houses. The Society is not responsible for statements advanced in this publication.

LABORATORY ITEMS

Dry Box—Semiconductors, miniature mechanical assemblies, tube components, and other moisture- and dust-sensitive items may be handled in rigidly controlled, dust-free atmospheres with the new "Hydrovoid" atmosphere control system. Adaptable to either inert gases or room air, the Hydrovoid contains an efficient desiccant system capable of attaining very low dew points within the Hydrovoid cabinet.
Air Shields, Inc. 3467

Laboratory Tape Recorder—A new portable magnetic tape recorder has been announced. The CP-100, a complete 7- or 14-channel recording and reproducing system, is a reliable reel-to-reel machine for instrumentation or general laboratory application.
Ampex Corp. 3468

Adiabatic Calorimeter—A new adiabatic calorimeter specifically designed for determining the purity of reference compounds used in spectroscopic and mass spectrometric studies is announced. The new instrument, called the Cary Model 41, is based on a design of the Shell Development Co.
Applied Physics Corp. 3469

Ultrasonic Tester—Of interest to users of ultrasonic test equipment and nuclear magnetic research is a balancing network, WB-100, to reduce the overload from the direct r-f pulse applied to receivers during single-crystal operation. This unit has BNC connections for input and output and plug-in coils for changing frequency from 0.5 to 80 Mc.
Arenberg Ultrasonic Laboratory, Inc. 3470

Insulation Leakage—Advantages of high-voltage d-c dielectric strength testing, formerly available only in larger instruments, are offered by the new D-C Hypot, Jr. series, weighing only 20 lb and operating from 110 v ac, recently announced. Three models are offered, with output continuously variable from 0 to 1500, 0 to 2500 and 0 to 5000 v dc.
Associated Research, Inc. 3471

Nuclear Magnetic Resonance—A new nuclear magnetic resonance controller for current-regulated power supplies will soon be made available. The NMR feature provides extreme accuracy in adjustment and control for direct currents. The instrument has the added feature of ripple elimination to provide an ultra-stable, pure d-c power source.
Automation Industries, Inc. 3472

Rosette Strain Gage—The special design of this unique strain gage offers several advantages not hitherto available in rosette gages. It is a very thin gage and has a maximum of sensing elements in a given area. The gages are made from materials specifically selected and treated to minimize temperature effects when bonded to several different types of materials. They are available in $\frac{1}{8}$ and $\frac{1}{4}$ in. sizes, in 45 and 60 deg. configurations, and on Epoxy, paper, or phenolic matrices depending upon the intended use.
Baldwin-Lima-Hamilton Corp. 3473

Bearing Analyzer—A new, all-electronic instrument designated BA-20-2 and designed specifically for the nondestructive analysis of ball and roller bearing quality has been introduced. Model BA-20-2 bases its analysis upon the vibrations produced by a rotating bearing, and it indicates unserviceable bearings, both visually and audibly, by means of a meter, CRT display, and a loudspeaker.
Bearing Inspection, Inc. 3474

Fraction Collectors—A complete line of fraction collectors consisting of 12 models to suit every collection method is announced. These units are made available for timed-collection and volumetric-siphon collection or with the specially designed transistorized Tri-Purpose activator for timed, volumetric-siphon, and drop-counting collections, all in one unit.
Buchler Instruments, Inc. 3475

Universal Fatigue Machine—A new Tatnall-Krouse universal testing machine for combination fatigue testing has been introduced. Labelled the Model LAZ-1, the new machine incorporates the well-recognized fatigue testing principles of B. J. Lazan of the University of Minnesota. Among its features are: detachable unitized components for direct test on structural members too large for the frame; a simple dynamic unit designed to function independently or with the static unit; and an automatic load cycling within adjustable limits (dynamic ± 5000 lb, static ±20,000 lb).
The Budd Co., Instruments Div. 3476

Magnetic Particle Inspection—Recordaflux, a completely new magnetic particle inspection system, has been introduced. Recordaflux, formerly known as Permaweld, is used to detect defective welds, cracks, inclusions, and other flaws in materials that are currently inspected by magnetic particle systems.
The Budd Co., Instruments Div. 3477

Particle Balance—A new balance, called the MF Electrobalance, for contaminant analysis is announced. This special version of the widely used Cahn Electro-

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LABORATORY ITEMS

(*Continued from page 80*)

balance is designed and equipped to weigh all sizes of millipore filters, for gravimetric determination of particulate contamination in air, rocket fuel, hydraulic fluid, and other gases and liquids.
Cahn Instrument Co. **3478**

Voltmeter—Newest in the line of electronic instruments for physics laboratory work is the new Cenco infinite-resistance voltmeter for measuring resistance in the megohm region. The new instrument is essentially an electrostatic voltmeter with a range of 0 to 20 v dc. The dial readings are in microamperes graduated from 0 to 500.
Central Scientific Co. **3479**

Metal Testing—A new materials-test machine for advanced cycling or fatigue testing of specimens or structures under compression-tension and elevated-temperature conditions has been introduced. Called the Dynatest, it is capable of cycling up to 20 cps, and of following a typical programmed heating rate of 200 F per sec. The maximum heating rate is dependent upon the configuration of the specimen.
CompuDyne Corp. **3480**

Strain-Gage Power Supply—Six new standard models of transistorized power supplies for strain gages having continuously variable output ranges from 0 to 30 v and 0 to 200 ma at input of 117 v (95 to 135) 60 cps, are announced.
Computer Engineering Associates, Inc. **3481**

Portable Test Instrument—All materials such as metal, plastics, textiles, wires, springs, leather, etc., can be easily tested with this new all-around Model M tester. Simple changes in grips quickly adapt the basic instrument for tests of tensile, compression, transverse, and shear forces.
W. C. Dillon & Co., Inc. **3482**

Rotating Microscope Stage—Said to have almost unlimited possibilities in laboratory and production-line work, a brand new rotating microscope stage now permits microscopic top-and-side examination of tiny subjects without moving them or holding by hand. An angled first surface mirror permits top-and-side viewing without the necessity of "upsetting" the subject or awkward holding by hand.
Edmund Scientific Co. **3483**

Tension Testing—New Model TM-100 tension machine designed especially for pulling reinforcing bars from Nos. 2 to 11 is announced. Two ranges are available as standard equipment: 0 to 30,000 lb and 0 to 250,000 lb. The TM-100 can be arranged to test stranded cable in tension and 6- by 17-in. cylinders in compression.
Forney's, Inc. **3484**

D-C to A-C Inverter—The unique feature of this unit is an output wave form that is a sine wave, with a maximum distortion of 5 per cent, which can work into a wide range of leads from 0 to full output. Output voltage varies with input voltage if this inverter is not used with a transistorized regulator.
Freed Transformer Co., Inc. **3485**

Tachometer—A completely new design of the stroboscopic tachometer, sold for many years under the trade name, Strobotac, and widely used in the mechanical and electrical industries for the measurement of rotating machine-part speeds and observation of their operation in slow motion, has been announced. Small and portable, the new model (Type 1531-A) features a fundamental speed (flashing-rate) range of 110 to 25,000 rpm and brilliant white light flashes with extremely short duration—1 to 6 microseconds—permitting fast action to be "stopped."
General Radio Co. **3486**

Polishing Cloth—A new polishing cloth especially suited for metallographic specimen preparation and metal finishing has been developed. It will produce the high, flat polishes required for metallographic analysis and precision finishing.
Geoscience Instruments Corp. **3487**

Friction Tester—The Hohman A-6 Tester for friction and wear testing of metal specimens is now available. The tester can be used for simulation of most types or combinations of wear, heat, and atmospheric conditions for evaluation of ring and cylinder wall wear, bearing wear and friction, and determining wear characteristics of all types of metals and alloys. It can also be used for the friction measurement of solid lubricants, plastics, and fibrous materials as well as oils and greases.
Hohman Plating & Mfg., Inc. **3488**

Temperature Controller—An accurate, new, electronic on-off controller and pyrometric temperature indicator is available in a single, compact instrument. Called the Alnor Pyrotroller, the unit has been designed for use on ovens, heat-treating furnaces, and environmental test chambers.
Illinois Testing Laboratories, Inc. **3489**

Thermometer—A line of new magnetically attaching bimetal dial thermometers has been released. Three styles of thermometers are available: thermometers for temperature measurement only; thermometers with maximum reset hand; and thermometers with electric contactor to permit "on-off" temperature control with electric resistance or induction heating.
Industrial Service Co. **3490**

Production Recorder—The K-Logger, a new type of multiple recorder and annunciator, has been introduced. It records and displays, on one chart, the production rates of each of a number of machines or processes, minute by minute, throughout a shift or a day. It also relates production rate to the temperature, amperage, speed, or other significant process variables existing at the time.
Keinath Instrument Co. **3491**

Vacuum Oven—A completely new laboratory oven, recently developed, now offers the highest temperature—combined with vacuum—that is available. Called the "Super-Temp" Duo-Vac Oven, it has a temperature range from room to 260 C (500 F) within an 11-in. diam by 12 in. deep stainless-steel vacuum chamber.
Labline, Inc. **3492**

Conductivity Monitor—A new 4957 conductivity monitor which continuously indicates an electrolytic conductivity measurement is announced. Designed for industrial use, the conductivity monitor is available with linear ranges from 0 to 1 to 0 to 5000 μmhos per cm (by proper choice of cell constant), and nonlinear ranges of 0 to 10 and 0 to 500 μmhos per cm.
Leeds & Northrup Co. **3493**

Centrifuge—A new, bench-model super-speed centrifuge, called the Versa-fuge,

(*Continued on next page*)

incorporating a built in safety shield and accommodating five interchangeable rotors for batch or continuous flow separations is announced.
Lourdes Instrument Corp. 3494

Thickness Tester—A completely transistorized battery-operated ultrasonic instrument for measuring wall thickness between 0.025 and 2.50 in. has been added to a broad line of test systems available. The portable unit, designed Sonizon SO-300, gives instantaneous reading by simply placing a transducer on the surface to be measured and turning a dial.
Magnaflux Corp. 3495

Volume of Materials—A new Dutch measuring device accurately determines isothermal, time-bound changes in volume of a variety of materials. Plastics, building materials, chemically hardening glues, and rubber are among the substances for which the set is ideally suited. Four identical dilatometers, which operate on the liquid-displacement principle, are part of the unit's thermostatically controlled measuring cabinet.
The Netherlands Trade Commission 3496

Potentiometer—Model 34LP linear-motion conductive-plastic potentiometer is now available. The potentiometer element of this linear-motion, infinite-resolution unit is made of conductive plastic material allowing the unit to operate in excess of 25 million cycles.
New England Instrument Co. 3497

Hardness Tester—A new portable hardness tester, with direct readings of Rockwell scales and accuracy maintained to ± ½ point, is announced. Available in both regular, Model 3R, and superficial, Model 3S, the units have 3-in. vertical capacity and 3-in. horizontal reach. Over-all size is 9 by 11 by 3½ in. for both models.
Northern Mfg. & Engineering Co. 3498

Radioactivity Gage—A new system that detects and measures radioactivity in gas or water is offered. Called the fluid monitoring system, it provides the large volume required for detection at MAC (maximum acceptable concentration) levels. Used in conjunction with NMC alpha and beta-gamma air particulate monitors, the system measures activity of the gaseous component of the discharge from these units.
Nuclear Measurements Corp. 3499

Worm Wheels—These precision wheels have been designed to reduce and minimize the backlash in worm and wheel assemblies for instruments. The wheels are made in bronze with stainless-steel hubs.
PIC Design Corp. 3500

Dye-Penetrant Inspection — "PIXchek," described as a versatile, quick, and economical dye-penetrant inspection system for detecting surface flaws in a wide variety of industrial materials has been introduced. PIXchek is said to be effective in finding defects in the exteriors and open sub-surface of metals, ceramics, glass, and most plastics and is especially useful as a quality-control tool in such industries as aircraft, missile, automotive, nuclear marine, pipelines, steel, and others.
Picker X-Ray Corp. 3501

Universal Tester—A new "Plastechon" universal tester capable of measuring tensile, flexural, and compressive properties of all types of materials at rates of loading ranging from 0.2 to 8,000 in. per min is available. Stress-strain curves are obtained automatically by oscilloscope-camera techniques. Outstanding engineering features include digital speed selection, servo response, and remote-control operation.
Plas-Tech Equipment Corp. 3502

Strain Indicator—A new portable completely transistorized strain indicator, Model HW-1, has been introduced. This strain indicator requires no phase balance adjustment to maintain sensitivity and accuracy, even when very long leads are used between instrument and strain gages. Total strain range is 60,000 microinches per in.; gage factor range is 1.5 to 4.5. Sensitivity is better than 1 microinch per in. This instrument can be used with all resistance-type strain gages having nominal resistance from 50 to 2000 ohms. Over-all dimensions are 6 by 9 by 6 in.
Polyphase Instrument Co. 3503

Tensile Test—A new specimen dimension compensator which automatically adjusts test recordings for dimensional changes in specimen thickness, width, diameter, or cross-section has been introduced. Designed for use with Scott Model CRE electronic testers and Scott Accr-O-Meter conversion kits, the specimen compensator now provides a fast, simple, accurate means of obtaining tensile-test recordings direct in psi, kg per sq cm, grams per tex, or other selected bases.
Scott Testers, Inc. 3504

Concrete Tester—A new portable concrete tester to perform compressive strength tests on 6-in. diam concrete cylin-

(*Continued on page 85*)

(*Continued from page 83*)

ders or 6 in. concrete cubes is available. The CT-710-B tester has a load capacity of 125 tons.
Soiltest, Inc. **3505**

Electronic Transmitter—The new Taylor 726T universal electronic transmitter is an indicating instrument with either an a-c or d-c electrical output. The transmitter is designed to function with any one of several dozen primary elements. Measurements might be absolute, differential, gage, or volumetric pressure; load; shaft position; or temperature.
Taylor Instrument Cos. **3506**

Chromatograph—A remarkable variable-gradient device for conventional chromatography or for a fully automated system is announced. Known as the Technicon Autograd, the device can supply automatically nearly any gradient requirement, in a continuous, uninterrupted flow. Compact, simple in design, and providing highest resolution, the glass-chambered Autograd automatically mixes eluent of varying compositions to hydrostatic equilibrium as the eluent passes from chamber to chamber.
Technicon Chromatography Corp. **3507**

Strain Gage—New Model SRB-75A strain gage module and hand servo gun are available. The servo gun is used to obtain automatic balance (null) of a strain-gage bridge or other bridge-type transducer. Model SRB-75A also contains a stable, highly regulated strain-gage power supply, automatic calibration circuits, and space for bridge completion resistors. Calibrating resistors and bridge completion resistors are mounted on a plug-in board inside the unit.
Video Instruments Co., Inc. **3508**

Taut-Band Instruments—New 100-deg indicating instruments (KX-251) for measuring d-c volts and amperes and employing both taut band suspension and core magnets are now available. The ammeter measures from 20 μa to 50 amp and the voltmeter measures from 35 mv to 800 v.
Westinghouse Electric Corp. **3509**

Metal Cutter—A cut-off machine capable of slicing semiconductor samples as thin as 0.005 in. is now available. Originally developed for dental research, the new Gillings-Bronwill thin sectioning machine has successfully sliced samples of non-decalcified bone, crystals, stone, ceramics, and petrographic materials.
Will Corp. **3510**

CATALOGS & LITERATURE

Infrared Data—New performance and design specifications are available on the infrared double-beam recording spectrophotometer (Models NK-1 and NK-1a) with automatic scan control and accelerated scan program for research and control recently introduced.
Baird-Atomic, Inc. **6290**

Flaw Detector—Ultrasonic flaw detection is the subject of the new 8-page, *Bulletin No. T200*, recently offered. The illustrated booklet includes operation, techniques, and a complete list of specifi-

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CATALOGS & LITERATURE

(*Continued from page 85*)

cations for the Sonoray 5 flaw detector.
Branson Instruments, Inc. 6291

Mass Spectrometer—A 6-page *Bulletin No. 21130,* describing a new Type 21-130 laboratory mass spectrometer, designed especially for laboratory analyses, is now available.
Consolidated Electrodynamics Corp. 6292

Instrument Catalog—Sixteen-page *Catalog No. 60* describes over 75 instruments for test work.
Custom Scientific Instruments, Inc. 6293

Tensiometer—"Surface Thermometers" is the title of a new 6-page *Bulletin No. FS-279* that describes two new instruments (one manual, one semiautomatic) for measuring surface tension and interfacial tension by the fast, accurate ring method. They are direct-reading instruments specified by ASTM Methods D 971 and D 1331.
Fisher Scientific Co. 6294

Chromatograph—A section, "Choosing your Gas Chromatograph," which compares in detail the integral features of F & M's five gas chromatographs is included in the new 6-page price list now available. The price list with product description covers the full line of analytical instrumentation now manufactured.
F & M Scientific Corp. 6295

Testing Equipment—Four-page folder, *Bulletin No. 28,* describes equipment for ASTM tests.
Humboldt Mfg. Co. 6296

Pyrometers—A new 6-page *Data Sheet ND42-35* describing pyrometers for temperature measurements up to 7600 F or 4200 C in plant or laboratory is now available.
Leeds & Northrup Co. 6297

Treatment of Industrial Water—"Instrumentation for Treatment of Industrial Water" is the title of a new *Booklet B96-2* recently published. The booklet describes typical water treating systems used in the processing industries. It shows how instrumentation has been applied to make these systems operate efficiently and economically.
Minneapolis-Honeywell Regulator Co. 6298

Sample Changer—A 4-page brochure on the new Nuclear-Chicago automatic sample changer for very-low-level solid-beta emitting radioactive samples is available. The new C115 automatic sample changer features a net background of only 2 counts per min. The low background makes it possible for the first time to measure with an automatic system samples producing only 2 to 3 counts per min in the detector.
Nuclear-Chicago Corp. 6299

Pellet Press—A hand-operated laboratory press for making pellets or tablets from powdered materials is described in a new *Bulletin No. 2811.* Interchangeable punch and die sets are employed to produce cylindrical pellets in four sizes from ¼ to ½ in. diam.
Parr Instrument Co. 6300

X-Ray Literature—A 20 page list of references spanning the years from 1930 to 1960, giving authors and publication names, article titles, and publication dates for 376 papers on X-ray analysis subjects is available.
Philips Electronic Instruments 6301

Vacuum Pump—Now available is a new *Bulletin No. 610* describing the recently expanded 2-stage vacuum pump line. Included in the 12-page, 2-color bulletin are complete descriptions, performance curves, specification charts, application data, as well as price and ordering information.
Precision Scientific Co. 6302

Laboratory Catalog—*Booklet 60,* a 60-page catalog of laboratory instruments designed and manufactured for science and industry, is now available.
E. H. Sargent & Co. 6303

Laboratory Catalog—Twenty-nine new items are illustrated and described in the new issue of "What's New for the Laboratory"—40th in the series.
Scientific Glass Apparatus Co., Inc. 6304

Sampling—A new line of concrete-testing drills that combine portability with heavy-duty action is described in a new two-page bulletin. The bulletin gives characteristics and capacities of all six testing drills in this line. The drills are for taking sample cores or for drilling holes in concrete, tile, asphalt paving, and similar hard materials.
Soiltest, Inc. 6305

Air Sampler—A brochure describes units for sampling large volumes of air for particulate matter by means of a filter paper. The unit, which employs a turbine-type blower principle, has proved successful in sampling air containing particles as small as 0.01 μ in diameter.
The Staplex Co. 6306

Ionization Gage—New series of ionization gage controls for the accurate and uniform measurement of ultra-high vacuum are described in a new *Data Sheet No. 563.*
F. J. Stokes Corp. 6307

Paper Catalog—A new 14-page catalog of replacement strip-chart papers has been published. A complete listing of replacement charts for all makes and models of recorders is included, with cross references to recorder manufacturers' model numbers.
Techni-Rite Electronics, Inc. 6308

Rubber Tester—Four brochures illustrate and describe various micro-indentation testers. The Model H5 for rubber, rubber-like materials, and plastics eliminates the need to mold standard size test specimens and permits the hardness of small parts, sheets, and irregular shapes to be measured directly.
Testing Machines, Inc. 6309

Servo-Amplifier—*Bulletin No. 91* describing and providing engineering information for new high-gain, d-c to a-c servo amplifier with matched impedance motor is available. The amplifier is most suitable in self-balancing instruments of laboratory accuracy, and can be used with any type of control instrumentation or automation where a transducer produces a change in voltage or resistance.
Thermo Electric Co., Inc. 6310

Ovens—A 12-page catalog, *Bulletin 71-TH-1960,* describing a complete line of industrial high-temperature, recirculating, gravity, and forced convection ovens is now available.
Trent, Inc. 6311

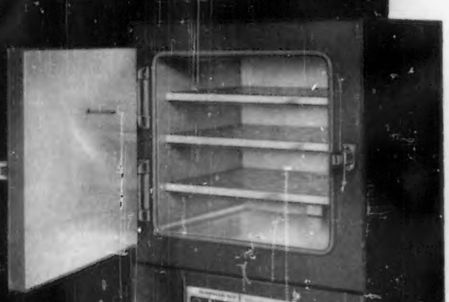
(*Continued on page 88*)

NEW...

SARGENT
ANALYTICAL OVEN

- HEAT TRANSFER BY RADIATION AND CONDUCTION
- OVER FOUR SQUARE FEET OF WORKING AREA
- DIRECT READING, SINGLE TURN TEMPERATURE ADJUSTING DIAL
- OPERATING RANGE, 35° TO 200°C
- ALL INSIDE METAL AREAS AND AIR VOLUME COINCIDENT IN TEMPERATURE WITHIN ± 2½°C WHETHER UNLOADED OR FULLY LOADED
- TEMPERATURE AT ANY POINT CONSTANT WITHIN ± ½°C WHETHER UNLOADED OR FULLY LOADED

Designed & Manufactured by
E. H. Sargent & Co.



S-64080 OVEN—Analytical, Radiation-Conduction Type, Double Wall, 200°C, Sargent. A new laboratory analytical oven designed to emphasize conduction and radiation as modes of heat transfer and to minimize the contribution of convection, thereby achieving an unprecedented uniformity of temperature throughout the entire cubic space of the isolated aluminum interior chamber.

The inner chamber is obstruction free. Three removable flat aluminum shelves and a flat bottom area provide over four square feet of useable space for moisture samples.

Heat is applied at a very low gradient and over a wide area from a nickel-chromium ribbon element in woven glass sleeving. 2½ inches of fiber glass insulation results in low wattage requirement and permits temperature to be regulated by a special Sargent heavy duty, bimetal regulator.

Temperature is adjusted by simple rotation of a single turn disk on the lower panel. A dial type thermometer is mounted on the door.

Constructed of heavy gauge, welded steel, finished in baked enamel. Inlet and outlet vents are provided. The oven door automatically opens if pressure builds up inside.

Range, 35° to 200°C; inside width, 14 inches; inside height, 13 inches; inside depth, 12 inches; outside width, 19 inches; outside height, 22½ inches; outside depth, 16 inches; net weight, 60 lbs. Complete with three shelves and thermometer. For operation from 115 volt, 50 or 60 cycle A.C. circuits **$165.00**

SARGENT *SCIENTIFIC LABORATORY INSTRUMENTS • APPARATUS • SUPPLIES • CHEMICALS*

E. H. SARGENT & COMPANY, 4647 W. FOSTER, CHICAGO 30, ILLINOIS

DETROIT 4, MICHIGAN • DALLAS 35, TEXAS • BIRMINGHAM 4, ALA. • SPRINGFIELD, N. J.

CATALOGS & LITERATURE

(*Continued from page 86*)

Vibration Test Systems—New 14-page bulletin describes shakers, power supplies, controls, and accessories of systems rated from 1250- to 2500-lb generated force, and developing up to 100 *g*. The 80 series systems start with manual controls and 850-lb rated force which can be economically expanded to 2500 lb.
Unholtz-Dickie Corp. 6312

Environmental Testing—The latest data on environmental testing and other applications for controlled atmospheric conditions is the subject of new 32-page *Brochure No. 600* now offered. A feature is a pictorial color chart summarizing latest known data at altitudes from sea level up to two million feet. It shows specific weight, pressure, acceleration of gravity, and molecular weight at the various altitudes. Other charts give technical information on atmosphere, temperature, and humidity.
Webber Manufacturing Co., Inc. 6313

INSTRUMENT COMPANY NEWS

Ormond Instrumentation Center, Inc., Los Angeles, Calif.—Announcement is made of the formation of Ormond Instrumentation Center, Inc., in Santa Fe Springs just outside of Los Angeles. The firm will specialize in strain measurement equipment including load cells and instrumentation. The firm is located at 11960 E. Slauson Ave., Santa Fe Springs, Calif.

Thermolyne Corp., Dubuque, Iowa—The corporate name of Thermo Electric Manufacturing Co. has been changed to Thermolyne Corp. The company will continue to manufacture furnaces, temperature controlling and indicating instruments, laboratory hot plates, magnetic stirring hot plates, etc., under TEMCO and THERMOLYNE trademarks.

LABORATORY NEWS

Charles C. Kawin Co., Chicago, Ill.—A filing-size brochure has just been published by Charles C. Kawin Co., Chicago and Buffalo, outlining in condensed form the metallurgical services available from this organization.

MATERIALS NEWS

Aluminum Alloy—A new group of aluminum alloys, displaying resistance to the corrosive attack of high-temperature steam and water, has been developed. The new Alcoa alloys were tested in both wrought and APM (aluminum powder metallurgy) forms. An APM alloy, containing 4.81 per cent iron and 7.03 per cent nickel, recorded the most spectacular results. Of all alloys evaluated at 680 F, the APM composition registered least susceptibility to corrosion.
Aluminum Company of America

Gasket Material—A new family of gasketing and packing materials made of fluorocarbon resins and inorganic fibers, that can be used at temperatures from −425 to +500 F with excellent torque retention and is unaffected by the common fuels, lubricants, hydraulic fluids, or solvents common to many industrial processes, has been developed. The new sheet materials, called Armstrong fluorocarbon accopacs, are inert to most chemicals over a wide range of temperatures and have a low coefficient of friction, which makes them useful as seals and packings in contact with moving parts.
Armstrong Cork Co.

New Palladium Alloy—A new palladium alloy is now available in the form of diffusion cells for the selective separation of ultra-pure hydrogen from hydrogen containing gas mixtures. These cells can be furnished by Bishop in sizes for laboratory, pilot plant, and commercial units.
J. Bishop & Co.

Metal-Filled Silicone Rubber—The development of a unique family of silicone rubbers which combine a high percentage of heavy metal particles, very finely divided and uniformly dispersed in silicone rubber has been announced. This new family of materials, designated COHRlastic HG, possesses the familiar properties of silicone rubber. From a series of initial tests conducted thus far, results show the unique properties of this metal-filled silicone rubber to be: broad temperature range (−85 to +500 F); extremely good resistance to weather, ozone, and ultraviolet light; good electrical resistance properties (10^{17} ohm per cm); high specific gravity; and resilience and flexibility.
The Connecticut Hard Rubber Co.

(*Continued on next page*)

MATERIALS NEWS

Tool Steel—Dargraph, a premium-quality oil-hardening graphitic tool steel, has been made available. This new steel offers resistance to abrasive wear, galling, scuffing, or scoring. Machining is easy, because one-third of Dargraph's carbon content is uniformly distributed as free graphite to increase its antifriction properties.

Darwin & Milner, Inc.

Epoxy Adhesives—A new, 8-page booklet describes five high-temperature epoxy resin formulations suitable for long-time service in the 450 to 500 F range. Two of the formulations are potting compounds, three are adhesives. The advantages and disadvantages inherent in the materials are described. Candid discussion of seven disadvantages given in the introduction serves to place the Epoxylite high-temperature compounds in the perspective of the present technology.

Epoxylite Corp.

OTS REPORTS

(*Continued from page 79*)

Development of Corrosion-Resistant Niobium-Base Alloys, May, 1960, BMI. 1437, $2.

Effect of Heat Treatment on the Corrosion of Zirconium: 2 atomic per cent Tin-2 atomic per cent Niobium, Jan., 1960, 50 cents.

Rate of Alloying of Uranium Alloys with Stainless Steel: Part 1, 1800 to 2300 F., June, 1960, $1.

Development of Ferritic Steels for High-Temperature Sodium Service, Part 1—2.25 Chromium, Molybdenum, 0.4 Columbium, 0.4 Titanium Experimental Alloy, May, 1960, $1.25.

Corrosion of Zirconium Alloys in 900 and 1000 F Steam, March, 1960, 50 cents.

Development of Molybdenum-Base Alloys, PB 161413, $2.75.

A Study of 17-7 pH Stainless Steel, PB 161089, $1.25.

Recent Advances in Titanium Technology, PB 161154, 50 cents.

The Welding of Titanium and Titanium Alloys, PB 151079, $1.75.

A Review of Certain Ferrous Castings Applications in Aircraft and Missiles, PB 151077, $1.50.

Effect of Heat Treatment on the Metallurgical and Mechanical Properties of 7Al-3Mo Titanium Alloy, PB 161363, $2.50.

Investigation of the Strength and Ductility Relationships in Titanium-Aluminum Alloys Between 6 and 15 per cent Aluminum for Application at Elevated Temperatures, PB 161424, $1.75.

The Effect of High-Temperature Recovery on the Creep of Polycrystalline Aluminum in the Dislocation Climb Region of Temperature, PB 161422, $1.

Short-Time, Elevated-Temperature, Stress-Strain Behavior of Tensile, Compressive, and Column Members, PB 161492, $2.75.

Low-Temperature Tensile-Hardness Correlations of SAE 4340 Steel, PB 161467, 50 cents.

Creep of Tantalum Under Cyclic Elevated Temperatures, IS-125, $1.75.

Combined Effects of Axial Load, Thermal Stress, and Creep in Flat Plates, PB 161087, $2.75.

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Quality Control and Applied Statistics Year Book

Edited by R. S. Titchen, A. J. Rosenthal, B. Bollerman, F. Nistico; Interscience Publishers, Inc., 1959; 1348 pp.; $60.00.

Adapted from publisher's description.

THIS BULKY volume is a collection of abstracts of papers dealing with quality control and applied statistics. The material was originally published in 1959 in technical journals in this and foreign countries and covers a wide range of topics relating to quality control techniques and applications. The alphabetical subject index alone covers 16 pages. An author index also is included.

The abstracts differ somewhat from those conventionally used. For convenience, each is set up with the usual title, author, and journal reference and in addition includes the purpose, a summary, a discussion of results, and occasionally additional references. Also, many items contain original data, graphs, charts, and photographs, making it unnecessary in many instances to refer to the original work.

The abstracts were published originally in looseleaf form. This bound and indexed volume will make them more accessible in libraries and for other reference purposes.

Precise Measurements of Heat of Combustion with a Bomb Calorimeter

R. S. Jessup; National Bureau of Standards Monograph 7, issued Feb. 26, 1960; 24 pp.; 25 cents. (Order from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

Adapted from publisher's description.

DATA ON the heat of combustion of a fuel are necessary for the calculation of engine performance, particularly in jet or rocket engines. This publication gives detailed descriptions of apparatus and methods used at the National Bureau of Standards for precise determinations of heats of combustion of liquid hydrocarbon fuels.

Standard methods for bomb-calorimetric measurement of heats of combustion of solid and liquid fuels published by the ASTM have an accuracy of several tenths of 1 per cent. Apparatus and methods have been reported for making measurements to 0.01 or 0.02 per cent. The attainment of such accuracy, however, involves laborious and time-consuming procedures.

In many fuel applications, the heat of combustion is required with an accuracy of approximately 0.1 per cent, which is probably not attainable with the ASTM methods, but which can be obtained with less time and effort than is required in the most precise measurements.

This Monograph describes the apparatus and methods used at the Bureau for such an intermediate determination. Numerical examples are given of methods for calculating the results of measurements from observed data. The accuracy of the method is approximately 0.1 per cent.

Included in the publication are techniques of making and filling glass bulbs to contain samples of the volatile liquid fuels.

Classifications of High Polymers: A Review

R. Howink and H. Bouman; Butterworths Scientific Publications, London, 1960; 54 pp.; $2.25.

Reviewed by P. E. Willard, Chemicals and Plastics Div., Ford Machinery and Chemical Corp.

THE PROBLEMS of classifying high polymers have been under study by the High Polymers Division of the International Union of Pure and Applied Chemistry since 1953. The present volume reviews 27 different existing systems now in use, and recommends certain of these systems for specific purposes.

Two general groups of people require polymer classification systems: (1) librarians and patent documentalists, who are concerned mainly with the composition of the materials, and (2) manufacturers and consumers, who are concerned mainly with the properties of the materials. All of the systems are compared on the basis of satisfying the needs of these two groups, and the advantages and disadvantages of each system are discussed and summarized. Of particular interest are attempts to develop systems not related to a particular language so that truly international usage can be assumed. The authors suggest the adoption of English as the international language for polymer classification purposes.

This book is recommended to persons involved in polymer classification systems as a clear, concise, well-organized review of the existing situation. Starting from the systems now in use it appears possible that some agreement on a system serving the needs of most users and applicable on an international basis can be developed. The authors are to be congratulated on a very fine survey of an area needing critical analysis to permit much needed unification of polymer classification.

The U. S. economy will nearly double in a little less than 20 years, according to economists at Arthur D. Little, Inc., international research firm. By 1975, gross national product will hit a record $835 billion, based on a projection from 1930. Total population of the U. S. will be an estimated 235 million; the labor force will total 94 million—an increase of 23 million wage earners.

OTS REPORTS

(*Continued from page 89*)

Investigation of Methods for Determining Actual Flaw Size in Materials by Nondestructive Ultrasonic Techniques, PB 161530, $1.75.
The Use of Ultrasonic Methods to Determine Fatigue Effects in Metals, PB 161487, 75 cents.
Research on the Mechanisms of Fatigue, PB 161412, $2.
Methods for Conducting Short-Time Tensile, Creep, and Creep-Rupture Tests Under Conditions of Rapid Heating, PB 151078, $1.25.
A Study of the Relationship Between Notched and Unnotched Specimens of 2024 Aluminum Alloy in the Low-Cycle Fatigue Regime, PB 161405, $2.
Fatigue Behavior of 2014-T6, 7075-T6, and 7079-T6 Aluminum Alloy Regular Hand Forgings, PB 161500, $1.
The Lower Critical Stress for Delayed Failure, PB 161532, $1.
Hydrogen Embrittlement in Terms of Modern Theory of Fracture, PB 161531, $1.
Machining Characteristics of High-Strength Thermal-Resistant Materials, PB 161369, $6.
Explosive Forging, PB 161457, $1.75.
Laws for Large Elastic Response and Permanent Deformation of Model Structures Subjected to Blast Loading, PB 161446, $1.75.
Preparation and Properties of Some Polyphenyls, PB 161508, $3.
Pressure-Induced Crystallization in Polyethylene, PB 161455, $2.25.
Pressure-Sensitive Tape Suspension Systems for Aircraft Parts in Shipping Containers, PB 161362, $1.
Pressure-Sensitive Tape Suspension Systems for Aircraft Parts in Shipping Containers, PB 151945, $1.75.
Electronic Designer's Shock and Vibration Guide for Airborne Applications, PB 161299, $4.
Candidate Materials for High-Temperature Fabrics, PB 161411, $3.

RANDOM SAMPLES

(*Continued from page 32*)

And Now—Plastic Housings for Jet Engines

A standard production-line jet engine with a reinforced-plastic compressor housing instead of the usual metal one has operated successfully for 150 hr at the Westinghouse Electric Corp. aviation gas turbine division in Kansas City, Mo.

The plastic, a polyester resin reinforced with glass fibers, resembles the type successfully employed in the nose cones of missiles. However, this marks the first time that a plastic component of such size and complexity has been used in an experimental jet engine and proved capable of withstanding all the rigors of full-scale engine operation.

Compressor housings for jet engines ordinarily are made from castings of aluminum or magnesium alloys, or they are sheet steel fabrications. With the new development, designers can expect compressor housings and similar components to be lighter, cheaper, more corrosion-resistant, and easier to manufacture. The plastic is more corrosion-resistant than aluminum or magnesium, especially to the damaging attack of salt water; and above a temperature of 450 F the plastic housing is considerably stronger than one made of either metal.

Inside the housing, the compressor rotates at speeds as high as 12,500 rpm. The clearance between the whirling blades and the housing must be maintained to an accuracy of a few hundredths of an inch. The whole assembly is designed and built with great precision, and it must retain that precision in spite of the pressure of the air pouring through it and in spite of high temperatures which tend to cause all such structures to warp or buckle.

For endurance testing, the housing was assembled in a standard Westinghouse J-34-WE-36 jet engine. After 50 hr of operation, the housing was removed and examined for any evidence of erosion of the plastic or its deterioration due to heat. None was found, so the engine was reassembled for completion of the 150-hr test. At the end of this time, the housing still was in excellent condition. Throughout the entire test the engine showed no loss in performance due to use of the nonconventional plastic compressor housing.

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Photographic Exhibit Winners

(*Continued from page 18*)

THIRD PRIZE: *Pyrolytic Graphite and Soot*, Mrs. T. V. Brassard, D. R. Ochar, R. R. Russell, General Electric Co., Schenectady, N. Y.

HONORABLE MENTION: *Intergranular Fatigue Fracture*, William Cain, Westinghouse Electric Corp., East Pittsburgh, Pa.

Color Transparencies

FIRST PRIZE: *Dislocations of an Aluminum Oxide Crystal*, R. R. Russell, General Electric Co., Schenectady, N. Y.

SECOND PRIZE: Set of six transparencies showing a number of color photomicrographs of α-brass with 72 per cent copper. Ramon Barklund, AB Svenska Metallverken, Laboratoriet Vasteras, Sweden.

THIRD PRIZE: *Heat Damage on Jute Shown by Iodine Sulphuric Acid Test*, Frederick Scott Young, Defense Standards Laboratories, Ascot Vale, Victoria, Australia.

HONORABLE MENTION: *Molybdenum Oxide Whisker*, James Nelson, Westinghouse Electric Corp., East Pittsburgh, Pa.

Electron Micrographs

Technique

FIRST PRIZE: *Rutherford Scattering of a Fission Fragment in 100 Å UO_2 Film*, T. S. Noggle and J. O. Stiegler, Oak Ridge National Laboratory, Oak Ridge, Tenn.

SECOND PRIZE: *90 Iron-10 Copper Powder Metallurgy Material*, G. H. Glade and D. H. Lane, Westinghouse Electric Corp., East Pittsburgh, Pa.

THIRD PRIZE: *Tin Oxide and Replica of Underside of Oxide*, P. S. Trozzo, U. S. Steel Corp., Monroeville, Pa.

HONORABLE MENTION: *Iron Sulfide Crystals: Reaction of H_2S with Iron Using Pfeffercorn Technique*, A. W. Bartunek, D. H. Oertle, and F. G. Rowe, Continental Oil Co., Ponca City, Okla.

HONORABLE MENTION: *Stages in the Growth of Tin Oxide at Low Pressure*, P. S. Trozzo, U. S. Steel Corp., Monroeville, Pa.

Dispersions

FIRST PRIZE: Not awarded.

SECOND PRIZE: *Hydration Products of $3CaO \cdot SiO_2$*, Kunihiro Takemoto, Onoda Cement Co., Ltd., Tokyo, Japan.

SECOND PRIZE: *Hydration Products of $3CaO \cdot SiO_2$ or β-$2CaO \cdot SiO_2$ with $3CaO \cdot Al_2O_3$*, K. Takemoto, Onoda Cement Co., Tokyo, Japan.

Replicas

FIRST PRIZE: *Ni_3Al Precipitate in a Nickel-Titanium-Aluminum Alloy*, A. S. Holik, General Electric Co., Schenectady, N. Y.

SECOND PRIZE: *Moisture Blush in Nitrocellulose Lacquer*, J. A. Lindquist, Shell Chemical Co., Union, N. J.

THIRD PRIZE: *Electrochemical Dissolution of Copper*, T. S. Noggle and J. O. Stiegler, Oak Ridge National Laboratory, Oak Ridge, Tenn.

HONORABLE MENTION: *Decomposition of an Austenitic 50 per cent nickel 50 per cent Iron Alloy at Room Temperature*, R. M. Slepian and N. I. Ananthanarayanan, Westinghouse Electric Corp., East Pittsburgh, Pa.

HONORABLE MENTION: *Nucleated Glass Showing the Growth of the Induced Nuclei*, Jean A. Coles, T. J. Phillips and F. C. Lin, Westinghouse Electric Corp., East Pittsburgh, Pa.

HONORABLE MENTION: *Striation Formation on Surface of Fe-12Al*, E. F. Koch, General Electric Co., Schenectady, N. Y.

HONORABLE MENTION: *Spiral Growth Pattern in a Single Crystal of Poly(Ethyleneoxide) Grown from Solution*, A. S. Holik, F. P. Price, General Electric Co., Schenectady, N. Y.

HONORABLE MENTION: *Application of Quantitative Metallography to Swelling in Uranium*, T. K. Bierlein and B. Mastel, General Electric Co., Richland, Wash.

(*Continued from page 92*)

Glass Panels Shield Out Electric Charge

Electrostatic shields of glass have been developed by Corning Glass Works for use as windows that drain off electromagnetic interference. The glass panels transmit 70 per cent of visible light, yet they successfully-eliminate static.

As windows in giant computers the glass panels carry off electric charges which otherwise would build up and throw off readings and computations made by delicate electronic devices. The windows permit visual check on equipment.

In one laboratory, the product is being used to shield out interference during low-level electropsychological recordings. The panel permits observation of the person undergoing the tests.

The shield consists of a panel of borosilicate glass coated on one side with a thin ($\frac{1}{16}$-millionths of an inch) transparent metallic film. This coating intercepts the radiated interference, which then can be grounded by such devices as conductive tape, carbon button, or clamp-on spring.

The glass resists thermal shock and corrosion and is easily maintained and cleaned. The hard, electrically conductive coating is permanently fired onto the suface of the glass and will not abrade.

Polyethylene Neutron Shields

Polyethylene, the material of a thousand uses, has come up with a new one—this time as a secondary shield for nuclear reactors and other atomic energy applications. This information comes from J. A. Neumann, president and director of research of the American Agile Corp., Cleveland Ohio. "Primary nuclear shields still are made of lead, which blocks the passage of gamma and other rays, but not neutrons," Dr. Neumann reports. "Polyethylene has been found to have excellent properties for shielding neutrons."

The high hydrogen content of polyethylene makes an excellent neutron barrier. In fact, intensive research work during the past decade proves polyethylene to be most effective. Further, unlike concrete block, polyethylene is not porous and does not absorb radiation.

Other Societies Events

September 26–29—**American Welding Society,** Fall Meeting, Hotel Penn-Sheraton, Pittsburgh, Pa.

September 27–29—**TAPPI** 11th Annual Testing Conference, Pantlind Hotel, Grand Rapids, Mich.

September 27–30—**Prestressed Concrete Inst.,** 6th Annual Convention, Statler-Hilton, New York, N. Y.

September 27–30—**Association of Iron and Steel Engineers,** Meeting and Exposition, Cleveland Public Auditorium, Cleveland, Ohio

October 2–5—**Society of Petroleum Engineers of AIME,** Fall Meeting, City Auditorium, Denver, Colo.

October 3–6—**National Sand and Gravel and National Ready Mixed Concrete Assns.,** Semiannual Meeting, Del Monte Lodge, Pebble Beach, Calif.

October 6–8—**American Association of Textile Chemists and Colorists,** Sheraton Hotel, Philadelphia, Pa.

October 9–13—**Electrochemical Society,** Shamrock Hotel, Houston, Tex.

October 10–12—**American Gas Assn.,** Annual Convention, Atlantic City, N. J.

October 10–12—**National Electronics Conference and Exhibition,** Hotel Sherman, Chicago, Ill.

October 10–13—**TAPPI and Canadian Pulp and Paper Industry,** 10th Corrugated Containers Conference, Royal York Hotel, Toronto, Ont.

October 10–14—**American Society of Civil Engineers,** Annual Convention, Hotel Statler, Boston, Mass.

October 10–14—**American Institute of Electrical Engineers,** Fall Meeting, Chicago, Ill.

October 11–15—**American Council of Independent Laboratories,** Annual Meeting, Deauville Hotel, Miami Beach, Fla.

October 12–14—**Oak Ridge National Laboratory,** 4th Conference on Analytical Chemistry in Reactor Technology and 1st Conference on Nuclear Reactor Chemistry, Gatlinburg, Tenn.

October 12–14—**American Vacuum Society,** 7th National Symposium, Cleveland-Sheraton Hotel, Cleveland, Ohio.

October 17–18—**American Coke and Coal Chemicals Inst.,** Annual Meeting, Greenbrier, White Sulphur Springs, W. Va.

October 17–19—**ASLE-ASME** Joint Lubrication Conference, Statler Hotel, Boston, Mass.

October 17–19—**American Oil Chemists Society,** Fall Meeting, New Yorker Hotel, New York, N. Y.

October 17–19—**International Congress on the Technology of Plastics Processing,** Royal Institute for the Tropics, Amsterdam, Holland.

October 17–21—**National Metal Congress and Exposition,** Conventional Hall, Philadelphia, Pa.

October 17–21—**The Metallurgical Society of AIME,** Fall Meeting, Sheraton Hotel, Philadelphia, Pa.

October 17–21—**Society for Nondestructive Testing,** Annual Convention, Benjamin Franklin Hotel, Philadelphia, Pa.

October 19–21—**National Society of Professional Engineers,** Fall Meeting, Hilton Hotel, Denver, Colo.

October 23–26—**American Gear Manufacturers Assn.,** Semiannaul Meeting, Edgewater Beach Hotel, Chicago, Ill.

October 24–26—**Engineers Society of Western Pennsylvania,** 21st Annual Water Conference, Penn Sheraton, Pittsburgh, Pa.

October 27–29—**National Paint, Varnish and Lacquer Assn.,** Annual Meeting, Drake Hotel, Chicago, Ill.

October 29–November 2—**Federation of Societies for Paint Technology,** Annual Meeting, Hotel Sherman, Chicago, Ill.

October 31–November 2—**Society of Rheology,** Annual Meeting, Mellon Inst., Pittsburgh, Pa.

November 2–4—**Society for Experimental Stress Analysis,** Annual Meeting, Hotel Claremont, Berkeley, Calif.

November 3–4—**National Slag Assn.,** Annual Meeting, Hotel Mayflower, Washington, D. C.

Federal Government Standards Index Changes

The Federal Supply Service of the General Services Administration is charged with the responsibility for establishing specifications to be used by the Federal Government for Procurement of materials and supplies. The GSA issues an annual Index of Initiation of Federal Specifications Projects, and monthly supplements.

The items listed below appeared in Supplements 3 and 4 for May and June, 1960.

INITIATIONS

Title	Type of Action	Symbol or Number	FSC Class	Assigned Agency & Preparing Activity
Supplement 3, May, 1960				
Color of Painted Metal General Office Furniture	Int. Am. 1	Fed. Std. No. 124	...	GSA-FSS
Paint, Varnish, Lacquer, and Related Materials; Methods of Inspection, Sampling, and Testing	Chg. Not. 1	Fed. Std. No. 141	...	DOD-Navy-Ships
Acetylene, Dissolved, Technical Grade	Rev.	BB-A-106a	6830	DOD-Army-CE
Aluminum Alloy, Plate and Sheet, 7075	Am. 1	QQ-A-283a	9535	DOD-Navy-Weps
Aluminum Bronze Bars, Rods Shapes, Drawn Strip, and Forgings	Rev.	QQ-A-630	9530	DOD-Army-Ord
Can, Petri, Culture Dish	Rev.	GG-C-120b	6640	DOD-Army-CmlC
Cloth, Coated, Vinyl, Wall Covering	New	CCC-C-408	8305	DOD-Army-QMC
Cord, Cotton, General Purpose, Sash and Venetian Blind	Am. 4	T-C-571b	4020	GSA-FSS
Dishes, Culture, Petri, Plastic	New	...	6640	VA
Graphite, Lubricating, Flake	Rev.	SS-G-659g	9620	USAF-MAMA
Paint, Interior, White and Tints, Fire-Retardant	Rev.	TT-P-26c	8010	DOD-Army-CE
Pigment, Zinc Oxide, Dry and Paste-In-Oil	New	TT-P-463a TT-P-00463	8010	GSA-FSS
Pigment, Zinc Yellow (Zinc Chromate), Dry	Am. 1	TT-P-465	8010	GSA-FSS
Porcelain Enamel Products and Major Household Appliances, Test Requirements for Packing of	Rev.	PPP-P-600	...	DOD-Army-Ord
Potassium Hydroxide, Technical	New	O-P-566	6810	DOD-Army-CmlC
Twine, Cotton, Mattress	Rev.	T-T-931a	4020	
Twine, Cotton, Seine	Rev.	T-T-881b	4020	
Twine, Cotton, Wrapping	Rev.	T-T-871c	4020	
Supplement 4, June ,1960				
Cloth, Cotton, Cheesecloth	Int. Am. 2	CCC-C-440	8305	GSA-FSS
Coth, Cotton, Duck, Single and Plied Filling Yarns (Flat)	New	CCC-C-00443	8305	GSA-FSS
Cloth, Cotton, Flannel, (Heavy, for Table Felts)	Rev.	CCC-C-460	8305	DOD-Army-QMC
Coating Compound, Rust Inhibitive, Fish Oil Base	New	TT-C-530a TT-C-00530	8030	DOD-Navy-Ships
Hose, Fire, Cotton, Rubber-Lined	Am. 6	ZZ-H-451a	4720	GSA-FSS
Hose, Plastic, Garden (Yarn-Reinforced)	New	...	4710 4720	GSA-FSS
Packaging, Packing, and Marking of Textiles Fabrics (Woolens, Worsteds Cottons, Silks, and Synthetics)	Rev.	PPP-P-51a	8305	DOD-Army-QMC
Sealer, Sanding, Lacquer Type (for Wood Furniture)	Rev.	TT-S-190b TT-S-00190a	8010	GSA-FSS
Synthetic Filaments, General Specification for Brushes	Int. Am. 2	H-S-951	9420	GSA-FSS
Tape, Pressure-Sensitive, Double-Coated	Rev.	UU-T-0091b	7510	GSA-FSS
Tool Steel, Carbon and Carbon Vanadium	Am. 1	QQ-T-580	9510	DOD-Army-Ord
Towel, Bath, Cotton, Terry	Int. Am. 1	DDD-T-551d	8305	GSA-FSS
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless 1100	Am. 1	WW-T-783c	4710	DOD-Army-QMC
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 2024	Am. 1	WW-T-785b	4710	DOD-Army-QMC
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 3003	Am. 1	WW-T-788c	4710	DOD-Army-QMC
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes Drawn, Seamless, 5052	Am. 1	WW-T-787b	4710	DOD-Army-QMC

WITHDRAWALS

Title	Type of Action	Symbol or Number	Assigned Agency	Reason for Withdrawal
Supplement 3, May, 1960				
Resistance Wire	Rev.	QQ-R-175	DOD-Navy-Ships	Navy Dept. requested project be discontinued until further notice

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FEDERAL GOVERNMENT INDEX CHANGES

(Continued from page 96)

SPECIFICATIONS AND STANDARDS APPROVED FOR PRINTING

Title	Type of Action	Symbol or Number
Supplement 3, May, 1960		
Acid, Sulfuric, Technical-Grade	Canc.	O-A-115
Aluminum Alloy Bars, Rods and Shapes, Extruded, 3003	Rev.	QQ-A-357a
Aluminum Alloy Bars, Rods, and Wire, Rolled, Drawn, or Cold-Finished, 3003	Rev.	QQ-A-356d
Cable, Power, Electrical, (Rubber-Insulated, Building-Type) and Wire, Electrical, (Rubber-Insulated, Building-Type)	Rev.	J-C-103b
Containers, Folding, Corrugated, Fiberboard (for Household Goods)	Canc.	PPP-C-570
Enamel, Odorless, Alkyd, Interior, Semi-Gloss, White and Tints	New	T1-E-509a
Funnel, Common, Laboratory, Fluted or Ribbed	Rev.	DD-F-796b
Funnel, Common, Laboratory, Smooth	Rev.	DD-F-806b
Iron and Steel, Sheet, Zinc-Coated (Galvanized)	Canc.	QQ-I-716
Paper, Kraft, Untreated, Wrapping	Rev.	UU-P-268e
Paper, Wrapping, Wet-Waxed	Rev.	UU-P-134b
Rope, Wire	Canc.	RR-R-571a
Solder, Lead Alloy, Tin-Lead Alloy, and Tin Alloy, Flux Cored Ribbon and Wire, and Solid Form	Am. 2	QQ-S-571c
Steel Bars and Forgings, Graphitic	Am. 5	QQ-S-628
Steel, Sheets, Carbon, Zinc-Coated	New	QQ-S-775a
Sulfuric Acid, Technical	New	O-S-809a
Thinner, Paint, Mineral Spirits, Volatile, "Odorless"	New	TT-T-295a
Wire, Copper, Hard-Drawn	Canc.	QQ-W-336a
Wire, Copper, Medium-Hard Drawn	Canc.	QQ-W-339
Wire, Copper, Soft or Annealed	Canc.	QQ-W-341a
Wire, Electrical and Nonelectrical, Copper, (Uninsulated)	New	QQ-W-343
Supplement 4, June, 1960		
Lubricants, Liquid Fuels, and Related Products, Methods of Testing	Chg. Not. 5	Fed. Test Method Std. No. 791
Aluminum Alloy Bars, Rods, and Shapes, Extruded, 2014	Rev.	QQ-A-261a
Aluminum Alloy Bars, Rods, and Shapes, Extruded, 2024	Rev.	QQ-A-267a
Aluminum Alloy Bars, Rods, and Shapes, Extruded, 7075	Rev.	QQ-A-277a
Aluminum Alloy Bars, Rods, and Wire, Rolled, Drawn, or Cold-Finished, 1100	Rev.	QQ-A-411d
Aluminum Alloy Bars, Rods, and Wire, Rolled, Drawn, or Cold-Finished, 2024	Rev.	QQ-A-268a
Aluminum Alloy Bars, Rods, and Wire, Rolled, Drawn, or Cold-Finished, 5052	Rev.	QQ-A-315a
Aluminum Alloy Bars, Rods, Wire, and Special Shapes, Rolled, Drawn, or Cold-Finished, 6061	Rev.	QQ-A-325b
Aluminum Alloy Bars, Rods, Wire, and Special Shapes, Rolled, Drawn, or Cold-Finished, 7075	Rev.	QQ-A-282a
Aluminum Alloy Bars, Rods, Wire, and Special Shapes, Rolled, Drawn, or Cold-Finished, 2014	Rev.	QQ-A-266a
Bearings, Roller	Canc.	FF-B-186
Bearing, Roller, Tapered	New	FF-B-187a
Belt, Safety, Industrial; Harness, Safety, Industrial; Strap, Safety Industrial	Rev.	KK-B-151d
Box, Folding (Chipboard, Laundry)	Canc.	UU-B-651c
Cement, Portland	Rev.	SS-C-192d
Methanol (Methyl Alcohol)	Rev.	O-M-232d
Pigment, Zinc-Yellow (Zinc Chromate), Dry	Am. 1	TT-P-465
Thread, Linen	Rev.	V-T-291c
Triphenyl Phosphate (for Use in Organic Coatings)	Rev.	TT-T-662b

PROMULGATIONS

Title	Type of Action	Symbol or Number
Supplement 3, May, 1960		
Carpet, Loop, and Rug, Loop, (Wool Pile, Knitted) (Superseding DDD-C-0080(GSA-FSS))	New	DDD-C-80a
Dibutyl Phthalate, Plasticizer (for Use in Organic Coatings) (Superseding TT-D-00301a(GSA-FSS) & TT-D-301)	Rev.	TT-D-301b
Drum, Metal Shipping, Steel (over 12 and Under 55 gal)	Am. 1	PPP-D-705a
Ethyl Glycol Monobutyl Ether (for Use in Organic Coatings) (Superseding TT-E-00776a(GSA-FSS) & TT-E-776)	Rev.	TT-E-776b
Ground Joint, Laboratory Glassware, Taper and Spherical (Superseding DD-J-00550(GSA-FSS) & DD-S-722a (in Part))	New	DD-G-675
Linseed Oil, Boiled, (for Use in Organic Coatings) (Superseding TT-L-00190(GSA-FSS) & TT-O-364)	New	TT-L-190a
Linseed Oil, Raw, (for Use in Organic Coatings (Superseding TT-L-00215(GSA-FSS) & TT-O-369)	New	TT-L-215a
Orthophosphoric (Phosphoric) Acid, Technical (Superseding O-P-00313a(GSA-FSS) & O-P-313)	New	O-O-670
Stopcock, Laboratory Apparatus, Taper-Ground (Superseding DD-S-00720(GSA-FSS) & DD-S-722a (in Part))	New	DD-S-720a
Stopper, Laboratory Apparatus, Taper-Ground (Superseding DD-D-00750(GSA-FSS) & DD-S-722a (in Part))	New	DD-S-750a
Tool Steel, Carbon and Carbon-Vanadium (Superseding QQ-S-00779(Army-Ord))	New	QQ-T-560
Towels, Paper	Am. 1	UU-T-591d
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 2024 (Superseding WW-T-785a)	Rev.	WW-T-785b
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 5052 (Superseding WW-T-787a)	Rev.	WW-T-787b
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 6061 and 6062 (Superseding WW-T-789a)	Rev.	WW-T-789b
Varnish, Asphalt (Superseding TT-V-0051b(GSA-FSS) & TT-V-51a)	Rev.	TT-V-51c

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